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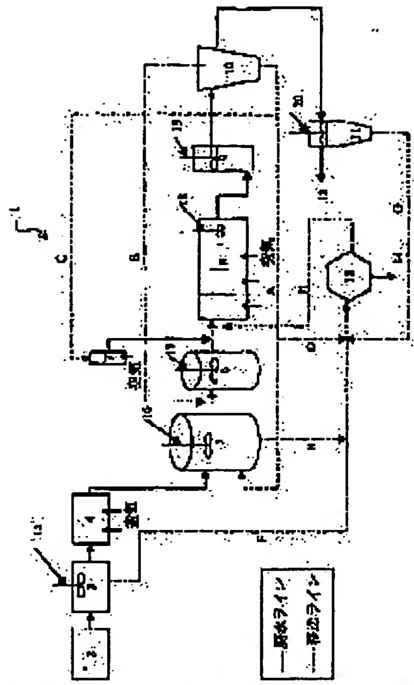
(54) **METHOD AND EQUIPMENT FOR TREATING HIGH-CONCENTRATION ORGANIC WASTE WATER USING BIOMAKER**



(57)Abstract:
PROBLEM TO BE SOLVED: To provide a waste water treatment method and an equipment used therefor capable of efficiently treating hardly degradable livestock waste water, or the like, of a high concentration.
SOLUTION: The waste water treatment equipment comprises an equalization tank, solid-liquid separation tank, ammonia stripping tank, anaerobic fermentation tank, anammox tank, biopond, denitrification induction type aeration tank, denitrification tank, settling tank, coagulation settling tank and dewatering tank; and the waste water treatment method uses the same.

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CLAIMS

[Claim(s)]

[Claim 1] (a) Equalization process which equates the concentration and the flow rate of high-concentration feces and urine or zootechnics waste water;

(b) the waste water equated at the aforementioned (a) process -- a flocculant -- in addition, solid-liquid-separation process; which adjusts the concentration of the organic substance, and the concentration of nitrogen to a desired level

(c) Ammonia stripping process which removes only ammoniacal nitrogen alternatively, without changing the concentration of the organic substance in the processed material by which solid liquid separation was carried out at the aforementioned (b) process;

(d) Anaerobiotic fermentation process which ferments the sludge which considered as the gestalt in which the aerobic bacteria in a consecutive process tend to take in the difficulty resolvability organic substance in the processed material processed at the aforementioned (c) process by decomposing using an anaerobic microorganism, and was transported from the following (i) process, and makes an organic acid generate;

(e) ANAMOKKUSU process which makes the nitrite nitrogen (NO2-) contained in the sludge given to anaerobiotic fermentation after being transported to the aforementioned (d) process from the following (i) process, and the ammonia contained in waste water react, and generates nitrogen gas;

(f) Microorganism activation process which exists in a biotechnology pound and which activates the solidified soil microbe;

(g) Denitrification induction type aeration process of mixing and performing denitrification after supplying the soil microbe activated at the aforementioned (f) process in a denitrification induction type aerator, disassembling the organic substance in the processed material processed at the aforementioned (e) process using the aerobic bacteria under habitation in a denitrification induction type aerator with this microorganism and nitrifying ammoniacal nitrogen to a nitrate nitrogen (NO3-);

(h) Denitrification process which returns the nitrate nitrogen in the processed material processed at the aforementioned (g) process using endoecism breathing of a microorganism in the state of anoxia to nitrogen;

(i) The waste-water-treatment approach including the coagulation-sedimentation process which removes the residual matter by condensation and is discharged as final-treatment water from the supernatant liquor which separated precipitate from the processed material and the mixture of a microorganism which were obtained at the (h) process at precipitate process; and the (j) aforementioned (i) process of carrying out solid liquid separation and transporting a part of sludge which precipitated to said anaerobiotic fermentation process (d).

[Claim 2] The waste-water-treatment approach according to claim 1 which does not supply a carbon source from the exterior in the aforementioned (h) process.
[Claim 3] (A) Equalization tub which equates the concentration and the flow rate of high-concentration feces and urine or zootechnics waste water;
(B) Chemical solid-liquid-separation tub which adjusts the concentration of the organic substance of waste water and the concentration of nitrogen which flowed from said equal tub to the level for which adds a flocculant and it asks;
(C) Ammonia stripping tub which removes only ammoniacal nitrogen alternatively, without changing the concentration of the organic substance in the processed material by which solid liquid separation was carried out;
(D) Anaerobic fermenter which it considers [fermenter] as the gestalt in which the aerobic bacteria in a consecutive process tend to take in the difficulty resolvability organic substance in the processed material supplied from said stripping tub by decomposing using an anaerobic microorganism, ferments the sludge transported from the setting tank, and makes an organic acid generate;
(E) ANAMOKKUSU tub which the nitrogen (NO2-) nitrous-acid-ized with the denitrification induction type aerator and the ammonia in a processed material react, and forms nitrogen gas;
(F) Biotechnology pound which it is equipped with the solidified soil microbe, activates this, and supplies said microorganism to a denitrification induction type aerator;
(G) Denitrification induction type aerator which performs denitrification after disassembling the organic substance in a processed material and nitrifying ammoniacal nitrogen to a nitrate nitrogen (NO3-) using the soil microbe activated in said biotechnology pound, and the aerobic bacteria under habitation to the interior of self;
(H) Denitrification tub which returns the nitrate nitrogen in the processed material which guided endoecism breathing of a microorganism in the state of anoxia, and was processed with said denitrification induction type aerator to nitrogen;
(I) Setting tank which the organic substance almost oxidizes and carries out solid liquid separation of the denitrification-ized processed material and the microorganism;
(J) coagulation sedimentation tub; which makes the residual matter condense from the supernatant liquor which carried out precipitate separation by said setting tank, and (K) -- the waste water treatment equipment containing the dehydration tack from which the part or all the moisture of the sludge discharged from said solid-liquid-separation tub, the anaerobic fermenter, the setting tank, and the coagulation sedimentation tub are removed.
[Claim 4] Waste water treatment equipment according to claim 3 which said denitrification induction type aerator is classified into at least four steps, and accommodation of mixing and the amount of dissolved oxygen can be performed, and equips the last stage without supply of air with the agitator for mixing.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technique in which invention belongs] This invention relates to the waste-water-treatment approach for processing organic waste water, such as high-concentration feces and urine or zootechnics waste water with many nitrogen components and the Lynn

components. Especially this invention relates to the waste-water-treatment approach of feces and urine with the high nitrogen and Lynn concentration which are characterized by including an ANAMOKKUSU process and a biotechnology pound process, or zootechnics waste water.

[0002]

[Description of the Prior Art] Processing of feces and urine and zootechnics waste water is very difficult, and is recognized as a time-consuming problem. it is now in spite of using various approaches for processing of feces and urine and zootechnics waste water -- it is alike and there is nothing that was accepted as a perfect processing technique. It is processed by the common disposal plant which feces and urine and zootechnics waste water are brought together in one place in consideration of the convenience of a maintenance and management in almost all cases, and is processed. However, in the waste-water-treatment method using a common disposal plant, processing of a high-concentration nitrogen component is the difficult present condition far compared with the high-concentration organic substance which exists in waste water, and an organic substance.

[0003] Furthermore, although processing of high-concentration feces and urine and zootechnics waste water is an art according [most] to dilution, since a dilution water must be used for such an approach in large quantities, it is inefficient-like [processing]. For example, in order for BOD to dilute the zootechnics waste water of 1 and 5000 mg/L, the dilution water which corresponds by this 75 times zootechnics waste water is required. It does not come out so much, and with the amount of a necessary dilution water, since a treatment facility also becomes large-scale, construction costs increase, and costs, such as an aeration facility and a peripheral device, also increase.

[0004] Since the present mode of processing of feces and urine or zootechnics waste water has put emphasis on removal of the organic substance, in the present condition, efficient removal of the nitrogen accepted as main causative agents of eutrophication of a lake and Lynn is not performed.

[0005] Research on feces and urine or zootechnics waste water treatment is done about various methods of construction. reference (it Gemeli(s) Bortone G. --) S. It reaches. Rambaldi and A., "Nitrification, denitrification, and biological phosphate removal in SBR treating piggery wastewater", To Wat, Sci.Tech, Vol, No.5-6, p977-985, and 1992 As a result of investigating about the load regulation of the waste water discharged in relation to nitrogen removal of zootechnics waste water, the ratio of the Japanese maximum stream flow and a mean daily discharge is 1.43, and it is indicated per time amount that the ratio of a minimum discharge and the maximum stream flow had a difference of 8 times or more.

[0006] Strous, M., and heijnen, J., Kuenen, J., and G. and -- Jetten and M.S.M."The sequencing batch reactor as a powerful tool for the study of slowly According to growing anaerobic ammonium-oxidizing microorganism", Appl.Microbiol.Biotechnol., Vol.50, p589-596, and 1998 The dominant of the microorganism which induces ANAMOKKUSU required the period of about one year for adapting oneself, it excelled in precipitate nature, and activity was 20microgN(NH4+ gestalt)/(mg biomass and h). Moreover, Van de Graff and A.A., Mulder, A., and de Bruijn, P., Jetten, and M.S.M., Robertson and L.A. and -- Kuenen, J.G., and "Anaerobic According to oxidation of ammonium in a biologically mediated process", Appl.Environ.Microbiol.Vol.61 p.1246-

1251, and 1995 The activity of ANAMOKKUSU is 66microgN(NH4+ gestalt)/(mg biomass and h), the activity of a microorganism is influenced by O2 of a minute amount, it depends for it on NO3- absolutely, and the amount of a microorganism is proportional to the biomass (biomass) in a cultivation tank directly.

[0007] To Andy, S., "Ammonia volatilization from a piggery pond", Wat.Sci.Tech, Vol.33, No.7, p183-199, and 1996 As a result of performing the trial to the ammonia volatility of **** (piggery pond), the rate of volatilization is 0.355-1.534g/(m3andd), and large deflection was shown with pH, And if volatilization removal of the ammonia is carried out, it is indicated that the inclination for pH and COD to decrease gradually appeared. moreover, Bicudo and J.R. and -- Svoboda, I.F., and "Intermittent aeration of pig slurry-farm scale experiments for carbon and nitrogen removal", To Wat.Sci.Tech, Vol.32, No.12, p83-90, and 1995 When the mixed liquor suspended solid in a reaction vessel (Mixed Liquor Suspended Solids, MLSS) operates in the state of 17,000 mg/L in an intermittent aeration process, It is indicated that the removal effectiveness of T-N (Total Nitrogen) of **** waste water was 86%.

[0008] this invention persons are the purposes which offer previously the waste-water-treatment approach and equipment which can be economical and can process efficiently high concentration waste water especially zootechnics waste water, and organic the-sex-industry waste water using a soil microbe, and proposed the waste-water-treatment approach using waste-water-treatment-equipment; and it which consist of a depot, an anaerobic fermenter, a microorganism activation tub, a mixing chamber, an aerator, a denitrification tub, a primary setting tank, a coagulation sedimentation tub, and a dehydrator (JP,2000-93998,A). However, the concentration of the suspended solid contained in zootechnics waste water or feces and urine shows a high value often like 50,000 - 60,000 mg/L. In such a case, it was difficult to maintain the MLSS concentration of an aerator appropriately by the conventional waste-water-treatment approach including the approach indicated by above-mentioned JP,2000-93998,A. So, even if it accepted the influent containing such a high-concentration suspended solid, the MLSS concentration of an aerator was maintained easily and the method of operating the whole waste water treatment equipment to stability was searched for.

[0009]

[Problem(s) to be Solved by the Invention] The purpose of this invention is offering the waste-water-treatment approach and equipment which can process effectively organic waste water, such as high-concentration difficulty resolvability zootechnics waste water with a high nitrogen content, and feces and urine.

[0010]

[Means for Solving the Problem] In order to attain the aforementioned purpose, this invention offers the new waste-water-treatment approach which combined the ANAMOKKUSU process and the biotechnology pound process. Furthermore, a solid-liquid-separation process is used for the approach of this invention instead of diluting waste water.

[0011] That is, this invention is an equalization process which equates the concentration and the flow rate of the feces and urine of (a) high concentration, or zootechnics waste water.;

(b) the waste water equated at the aforementioned (a) process -- a flocculant -- in addition, solid-liquid-separation process; which adjusts the concentration of the organic

substance, and the concentration of nitrogen to a desired level
(c) Ammonia stripping process which removes only ammoniacal nitrogen alternatively, without changing the concentration of the organic substance in the processed material by which solid liquid separation was carried out at the aforementioned (b) process;
(d) Anaerobiotic fermentation process which ferments the sludge which considered as the gestalt in which the aerobic bacteria in a consecutive process tend to take in the difficulty resolvability organic substance in the processed material processed at the aforementioned (c) process by decomposing using an anaerobic microorganism, and was transported from the following (i) process, and makes an organic acid generate;
(e) ANAMOKKUSU process which makes the nitrite nitrogen ($NO2-$) contained in the sludge given to anaerobiotic fermentation after being transported to the aforementioned (d) process from the following (i) process, and the ammonia contained in waste water react, and generates nitrogen gas;
(f) Microorganism activation process which exists in a biotechnology pound and which activates the solidified soil microbe;
(g) Denitrification induction type aeration process of mixing and performing denitrification after supplying the soil microbe activated at the aforementioned (f) process in a denitrification induction type aerator, disassembling the organic substance in the processed material processed at the aforementioned (e) process using the aerobic bacteria under habitation in a denitrification induction type aerator with this microorganism and nitrifying ammoniacal nitrogen to a nitrate nitrogen ($NO3-$);
(h) Denitrification process which returns the nitrate nitrogen in the processed material processed at the aforementioned (g) process using endoecism breathing of a microorganism in the state of anoxia to nitrogen;
(i) From the supernatant liquor which separated precipitate from the processed material and the mixture of a microorganism which were obtained at the (h) process at precipitate process; and the (j) aforementioned (i) process of carrying out solid liquid separation and transporting a part of sludge which precipitated to said anaerobiotic fermentation process (d), condensation removes the residual matter and the waste-water-treatment approach including the coagulation-sedimentation process discharged as final-treatment water is offered.
[0012] Such a waste-water-treatment approach of this invention is an equalization tub which equates the concentration and the flow rate of the following feces and urine of equipment:(A) high concentration, or zootechnics waste water.;
(B) Chemical solid-liquid-separation tub which adjusts the concentration of the organic substance of waste water and the concentration of nitrogen which flowed from said equal tub to the level for which adds a flocculant and it asks;
(C) Ammonia stripping tub which removes only ammoniacal nitrogen alternatively, without changing the concentration of the organic substance in the processed material by which solid liquid separation was carried out;
(D) Anaerobic fermenter which it considers [fermenter] as the gestalt in which the aerobic bacteria in a consecutive process tend to take in the difficulty resolvability organic substance in the processed material supplied from said stripping tub by decomposing using an anaerobic microorganism, ferments the sludge transported from the setting tank, and makes an organic acid generate;
(E) ANAMOKKUSU tub which the nitrogen ($NO2-$) nitrous-acid-ized with the

denitrification induction type aerator and the ammonia in a processed material react, and forms nitrogen gas;
(F) Biotechnology pound which it is equipped with the solidified soil microbe, activates this microorganism, and supplies said microorganism to a denitrification induction type aerator;
(G) Denitrification induction type aerator which performs denitrification after disassembling the organic substance in a processed material and nitrifying ammoniacal nitrogen to a nitrate nitrogen ($NO3-$) using the soil microbe activated in said biotechnology pound, and the aerobic bacteria under habitation to the interior of self;
(H) Denitrification tub which returns the nitrate nitrogen in the processed material which guided endoecism breathing of a microorganism in the state of anoxia, and was processed with said denitrification induction type aerator to nitrogen;
(I) Setting tank which the organic substance almost oxidizes and carries out solid liquid separation of the denitrification-ized processed material and the microorganism;
(J) coagulation sedimentation tub; which makes the residual matter condense from the supernatant liquor which carried out precipitate separation by said setting tank, and (K) -- it is performed by the equipment for waste water treatment containing the dehydration tack from which the part or all the moisture of the sludge discharged from said solid-liquid-separation tub, the anaerobic fermenter, the setting tank, and the coagulation sedimentation tub are removed.
[0013] Said waste-water-treatment approach of this invention and the 1st description of equipment are carrying out solid liquid separation through a chemical solid-liquid-separation tub instead of diluting the concentration of suspended matter with the high concentration of the organic substance to the proper level.
[0014] The 2nd description of this invention is that the concentration of the organic substance in waste water contains the ammonia stripping tub which can remove alternatively only the ammonia which is a nitrogen component, without making it change.
[0015] The 3rd description of this invention is that the anaerobic fermenter which a precipitate sludge is fermented with an anaerobic fermenter, is made to generate an organic acid, and utilizes this organic acid for removal of Lynn is included.
[0016] The 4th description of this invention is that the ANAMOKKUSU tub which transports the supernatant liquor of a setting tank, oxidizes $NH4+$ in waste water by $NO2-$, and generates nitrogen gas is included.
[0017] The 5th description of this invention is that the biotechnology pound which is filled up with the biotechnology comp which solidified the soil microbe, equips with a biotechnology manufacturer, activates a microorganism, promotes the activity of consecutive aerobic bacteria, and raises processing effectiveness is included. Here, a biotechnology pound means the structure which consists of a biotechnology manufacturer, a diffuser, etc., a biotechnology manufacturer says the microorganism activation equipment containing biotechnology comp and a crushed stone layer, and biotechnology comp means the microorganism fixed object which made the soil microbe fix.
[0018] The 6th description of this invention is that the biotechnology pound which makes intake capacity of the organic substance the maximum with a denitrification induction type aerator is included by intercepting the inflow of the raw water to a biotechnology pound, and carrying out fixed period hunger of the microorganism.

[0019] The 7th description of this invention is that the denitrification induction type multistage aerator which does not supply air to the partition of the end of an aerator, but equips it with the agitator for mixing, and has the partition classified so that denitrification in an aerator and denitrification by the consecutive denitrification tub might be promoted and which was preferably classified into at least four steps is included. By this, mixing of a microorganism and a processed material and accommodation of the amount of dissolved oxygen become smooth, and economical operation of waste water treatment equipment is attained.

[0020] The 8th description of this invention is that the setting tank which supplies the precipitate sludge of a setting tank to a biotechnology pound, promotes the activity of a microorganism, transports supernatant liquor to an ANAMOKKUSU tub, and removes nitrogen is included.

[0021] The 9th description of this invention is that process with a flocculant the organic substance, nutrient, and suspended solid which remain in a processed material, and the coagulation sedimentation tub which can process stable and efficient water quality is included.

[0022]

[Embodiment of the Invention] Below, with reference to the block diagram and the example of a trial of a waste-water-treatment process which were shown in the attached drawing, this invention is explained further at a detail.

[0023] Drawing 1 is a flow chart which shows the example of representation of high-concentration feces and urine or down stream processing of zootechnics waste water by this invention. Waste water treatment equipment 1 is equipment which processes high-concentration feces and urine and zootechnics waste water, and is constituted as follows.

[0024] The description of zootechnics waste water changes with time amount, seasonal factors, etc. fairly [the flow rate and concentration] sharply. The equal tub 2 equates the flow rate and concentration of waste water with sharp fluctuation in this way. The suspended solid and organic nitrogen in waste water are processed with flocculants, such as ferric chloride, and it is made to become the concentration which suited consecutive processing in the chemical solid-liquid-separation tub 3. Among the nitrogen component which exists in waste water, NH_3 will come to vaporize in atmospheric air, if air is puffed out. In the ammonia stripping tub 4, supply of air removes only ammoniacal nitrogen without loss of an organic substance alternatively by such principle.

[0025] The anaerobic fermenter 5 hydrolyzes the difficulty resolvability organic substance in the state of an anaerobiosis among the flowing processed material using an anaerobic microorganism, ferments the sludge transported from the setting tank 10, and generates an organic acid. In the ANAMOKKUSU tub 6, NO_2^- (generated by an aerator 8, especially the denitrification induction type multistage aerator) reacts with NH_4^+ in the state of an anaerobiosis, and generates N_2 gas, and in atmospheric air, this nitrogen gas vaporizes and is removed.

[0026] The biotechnology pound 7 activates the solidified soil microbe, and supplies an aerator 8 and a microorganism especially applicable to a denitrification induction type multistage aerator. It activates in said biotechnology pound 7, and the organic substance is oxidized not only using the supplied microorganism but using the oxygen supplied continuously, and aerobic bacteria, such as a microorganism which nitrifies ammoniacal nitrogen, are carrying out the abundant activity at this aerator 8. In the denitrification tub

9, nitrogen gasification is carried out in the state of anoxia, and the nitrified nitrogen vaporizes to atmospheric air.

[0027] Solid liquid separation of the processed material and microorganism which were processed by the anaerobic fermenter 5, the aerator 8, and the denitrification tub 9 is carried out by gravity by the setting tank 10. Finally the residual suspended solid which remains in a processed material, Lynn, and an organic substance are processed in the coagulation sedimentation tub 11 using a chemical. In this waste water treatment equipment, when the sludge generated in the chemical solid-liquid-separation tub 3, the anaerobic fermenter 5, the setting tank 10, and the coagulation sedimentation tub 11 passes through a dehydrator 12, the moisture content decreases. the supernatant water of the coagulation sedimentation tub 11 carries out the last discharge as a final effluent 13 -- having -- dehydration of a dehydrator 12 -- a cake 14 is sent to a compost shed, and it is used for manufacture of a compost or it is given to a landfill.

[0028] In this waste water treatment equipment 1, the moving trucking of a sludge is also very important with the moving trucking of a processed material. The moving trucking of the sludge in this invention is as having expressed with the dotted line to drawing 1 . If it explains concretely, the precipitate sludge by which solid liquid separation was carried out by the setting tank 10 will move to the anaerobic fermentation tub 5 through Path A, will generate an organic acid by anaerobiotic fermentation there, and will play the role which maintains the MLSS (suspended solid in mixed liquor) concentration of the denitrification induction type multistage aerator 8. An excessive waste sludge unnecessary to maintenance of the MLSS concentration of an aerator 8 is transported to a dehydrator 12 through Path D. Furthermore, the precipitate sludge of a setting tank 10 is transported also to the biotechnology pound 7 through Path C. On the other hand, the supernatant water of a setting tank 10 is transported to the ANAMOKKUSU tub 6 through Path B. The precipitate sludge of the coagulation sedimentation tub 11 is transported to a dehydrator 12 through Path G. The precipitate sludge of the chemical solid-liquid-separation tub 3 is transported to a dehydrator 12 through Path F, and the sludge of the remainder of the anaerobic fermentation tub 5 is transported to a dehydrator 12 through Path E. furthermore, dehydration generated with a dehydrator 12 -- a cake should be used as a compost, or a landfill should be carried out, and supernatant liquor should pass Path H -- an aerator 8 -- desirable -- a denitrification induction type multistage aerator -- it is especially transported to a four-step aerator preferably. Hereafter, unless it refuses especially about the structure, a denitrification induction type multistage aerator is only pointed out by name called an aerator 8.

[0029] It will be as follows if roles, such as each reaction vessel, and operation in the waste water treatment equipment 1 of this invention are further explained to a detail.

[0030] Feces and urine and zootechnics waste water which are a processed material express very various generating aspects. An yield and generating concentration are very various by the source location, the seasonal factor, time amount, etc. Thus, it is indispensable to make concentration and a flow rate into homogeneity first, in order to process the intense waste water of the range of fluctuation in order to process consecutiveness smoothly. The equalization tub 2 plays the role which equates the amount and concentration of the waste water irregularly discharged from a generating part. Two to 3 times are suitable for the size of an equal tub on the basis of a mean daily discharge. Since generating of an odor is an intense part, an equal tub can send a part of

sludge of a setting tank 10 to an equal tub depending on the need, and can also reduce generating of an odor (not shown).

[0031] The processed material equated by the equal tub is transported to the chemical solid-liquid-separation tub 3. Since the concentration of a suspended solid and an organic substance is high, for efficient processing, the transported processed material is this separation tub, and pretreats using a chemical, for example, a flocculant like a ferric chloride. It is very difficult to maintain the amount of MLSS(s) of an aerator 8 appropriately especially, since the concentration of an organic substance is high on a property for zootechnics waste water and there are many suspended solids moreover discharged from ** of stools and feed. In order to solve such a problem, in the chemical solid-liquid-separation tub 3, a little flocculant is added to the processed material which passed through the equal tub 2, and with some organic substance, a suspended solid and organic nitrogen are settled and it removes. As a flocculant, anionic, a cationic polymer, or a ferric chloride can be used according to the description of waste water. Thus, the produced precipitate sludge is transported to a dehydrator 12 through the path F of drawing 1 , and, finally dehydration processing is carried out.

[0032] In the processed material removed in the precipitate sludge, quite a lot of nitrogen components are contained compared with an organic substance by the chemical solid-liquid-separation tub 3. This generates lack of an organic substance in consecutive down stream processing, and makes efficient processing difficult. Therefore, in order to remove alternatively the ammoniacal nitrogen which occupies 60 - 70% in a nitrogen component without making an organic substance lose, a processed material is sent to the ammonia stripping tub 4.

[0033]

[Formula 1]

$$NH_3 + H_2O \rightleftarrows NH_4^+ + OH^-$$

[0034] Although ammoniacal nitrogen is maintaining equilibrium like an upper type, if pH of waste water increases to 7.0 or more, a balance will move to left-hand side and NH4+ ion will be converted into NH3. This NH3 will vaporize in atmospheric air, if waste water is stirred. By the ammonia stripping tub 4, supply of air removes the ammoniacal nitrogen in zootechnics waste water using the point (pH 9-9.5) that such a principle and pH of the zootechnics waste water itself are high.

[0035] The processed material removed in ammoniacal nitrogen by the ammonia stripping tub 4 flows into the anaerobic fermenter 5. In the anaerobic fermenter 5, it decomposes using an anaerobic microorganism and the difficulty resolvability organic substance contained in the processed material is made into the gestalt which aerobic bacteria tend to take in in a consecutive process. to the anaerobic fermenter 5, temperature is uniformly maintainable at about 30 degrees C -- as -- warming -- it is desirable to install a facility. By this, the fall of the nitrogen removal effectiveness by the temperature fall of winter can be prevented, and the smooth activity of an anaerobic microorganism can be secured. Furthermore, to the anaerobic fermenter 5, it is desirable to install the agitator 16 for mixing so that the gas (for example, CH4, CO2, H2, H2S, etc.) which an anaerobic microorganism is smoothly mixed with a processed material in the case of the inflow of an anaerobic microorganism, makes, and occurs can be smoothly desorbed from a microorganism.

[0036] Furthermore, the sludge of the lower part of the anaerobic fermenter 5 is extracted periodically, and is transported and processed to a dehydrator 12 through the path E of drawing 1 . The anaerobic fermenter 5 carries out anaerobiotic fermentation of the sludge transported from the setting tank 10, makes organic acids, such as an acetic acid, a propionic acid, ****, a valeric acid, and a capric acid, form, and activates the dephosphorylation microorganism contained in the sludge in the state of the anaerobiosis of the anaerobic fermenter 5. Activation of a dephosphorylation microorganism is performed as everyone knows in a field by [, such as control of suitable temperature, pH, the residence time, concentration, and the interfering substance,] preparing a surrounding environment so that growth of a dephosphorylation microorganism may be suited for the time being. The activated microorganism emits microorganism intracellular Lynn (P) with the gestalt of phosphoric-acid ion (PO43-), and takes in a lot of [far] Lynn than emitted Lynn in the state of aerotropism. In this process, with the anaerobic fermenter 5, said microorganism accumulates the organic acid produced by fermentation in the inside of the body, and it is used for it as an energy source. Furthermore, the anaerobic fermenter 5 also plays the role which denitrifies secondarily the residual nitrogen by which denitrification is not carried out completely. In the anaerobic fermenter 5, it is necessary to restrict the residence time of the processed material in the interior on two - the 3rd so that it may not move from an organic-acid formation reaction to a methanogenesis reaction.
[0037] The processed material which fermented with the anaerobic fermenter 5 flows into the ANAMOKKUSU tub 6. The supernatant liquor of a setting tank 10 also flows into the ANAMOKKUSU tub 6 through the path B of drawing 1 . In the state of an anaerobiosis, nitrite ion (NO2-) or nitrate ion (NO3-) is used for an electron acceptor, CO2 is used for the only carbon source for ammonium ion (NH4+) at an electron donor, and ANAMOKKUSU (Anammox) means the process in which ammonium is oxidized in N2 gas, by the ANAMOKKUSU microorganism. Such a generalization reaction formula of an oxidation process is as follows.
[0038]
[Formula 2]

$$1NH_4^+ + 1.32NO_2^- + 0.066HCO_3^- + 0.13H^+ \xrightarrow{\text{アナモックス微生物}} 1.02N_2 + 0.26NO_3^- + 0.066CH_2O_{0.5}N_{0.15} + 2.03H_2O$$

[0039] The ANAMOKKUSU tub 6 makes nitrogen gas return the nitrite and nitrate which exist in the supernatant liquor of a setting tank 10 by the ANAMOKKUSU microorganism which exists in a processed material by such principle. warming for maintaining an ANAMOKKUSU microorganism to proper temperature, for example, 20-40 degrees C, at the ANAMOKKUSU tub 6 -- it is desirable to install a facility. The ANAMOKKUSU microorganism is mainly known as a microorganism of the Nitrosomonas (Nitrosomonas) network, and there is flexible SHIBAKUTA (Flexibacter) as a typical example (Mike S.M.Jetten et al., The anaerobic oxidation of ammonium, FEMS Microbiology Reviews 22 (1999) 421-437). Furthermore, in order to make smooth accommodation of temperature, and mixing of a microorganism and a processed material, it is desirable to install the agitator 17 for mixing.
[0040] As for the biotechnology pound (biopond) 7, it is equipped with the biotechnology

manufacturer 30 with whom the biotechnology comp (bio-comp) 40 was filled up into the interior as shown in drawing 2 . The lower part is filled up with the crushed stone layer with many mineral constituents including the biotechnology comp 40 to which the biotechnology manufacturer 30 made the upper part carry out mixed immobilization of the various microorganisms. As a crushed stone, what contains SiO230.7%, 2O312.2% of aluminum, and CaO32.5% as a principal component, for example is used. This crushed stone layer supplies an inorganic substance succeedingly in the biotechnology manufacturer 30, and activity of the microorganism of biotechnology comp is maximumized with this supplied inorganic substance. Biotechnology comp is the microorganism fixed object which made the bacillus (bacillus) system microorganism and the soil microbe to which actinomycetes (actinomycets) make the mainstream fix so much. The soil microbe fixed by biotechnology comp is activated by the sludge transported from the setting tank 10, and the suitable growth conditions of a microorganism formed in the biotechnology pound. First, a microorganism is activated in the state of the aerotropism formed of the air continuously supplied to the biotechnology pound 7. Time amount necessary although it activates is about two days. The activity of the microorganism in the biotechnology pound 7 is further promoted by the sludge transported from the setting tank 10. Moreover, in case this microorganism flows into an aerator 8 henceforth by not supplying sufficient food for the microorganism activated in this way (namely, thing for which raw water is not supplied to a biotechnology pound), more flourishing metabolism capacity is demonstrated.

[0041] The processed material processed by the ANAMOKKUSU tub 6 and the microorganism activated in the biotechnology pound 7 flow into the denitrification induction type aerator 8. The multistage type aerator which only stirs the last stage and does not supply air as an aerator 8 is desirable, and what has four or more steps of partitions is more desirable. This is for bringing about good nitrification and good denitrification, maintaining the change in an alkali level with sufficient balance, and preventing the inhibitory action by rapid reduction of pH by maintaining the dissolved oxygen concentration which carries out difference to smooth mixing. When the large zootechnics waste water of a concentration difference flows serially, the aerator classified into four or more steps compared with the aerator (the number of stages which supplies air is 1-2 steps) classified into 2-3 steps is easy to adjust and operate to the suitable dissolved oxygen concentration corresponding to change of pH, and can make denitrification in a denitrification layer easy by operating the last stage in the state of anoxia. Especially, since a maintenance is easy, especially a four-step aerator is desirable. When there is specifically much NO3-concentration of the treated water which flows into the 3rd step in the case of a four-step aerator, the dissolved oxygen concentration of the 1st step and the 2nd step is reduced, denitrification of NO3- is planned, when NO3-concentration is low, the dissolved oxygen concentration of the 1st step and the 2nd step can be raised, and nitrification can be advanced.

[0042] As for the case of the last stage, i.e., a four-step aerator, it is desirable by installing the agitator 19 for mixing and maintaining the amount of dissolved oxygen to 0.5 or less mg/L to make it the effectiveness of the denitrification process which is a consecutive process become the maximum, and to carry out pH buffer action of an aerator by the increment in the alkalinity by a part of denitrification, without supplying air to the 4th step. The aerobic bacteria in an aerator 8 perform oxidation of the organic substance,

nitrification, and a removal operation of Lynn by superfluous intake of Lynn through a metabolism operation. In this process, the microorganism activated in the biotechnology pound 7 achieves a more flourishing metabolism operation. Ammoniacal nitrogen is the process in which it oxidizes to NO3- through NO2-, and is this process, an alkaline substance is consumed by Nitrosomonas (Nitrosomonas) and Nitrobacter (Nitrobacter), and, as for the nitrification reaction in an aerator 8, the effectiveness that pH falls is acquired.

[0043] The phenomenon of taking in a lot of [a microorganism / when the dephosphorylation microorganism to which the removal reaction of Lynn in an aerator 8 emitted Lynn with the gestalt of a phosphoric acid with the previous anaerobic fermenter 5 compounds a cytoplasm constituent with the aerator 8 of an aerobic condition] Lynn than Lynn which the existing aerobic bacteria take in happens. This is called superfluous intake (Luxury uptake) phenomenon of Lynn. Lynn is removable by this removing the sludge by which superfluous intake was carried out. Although said dephosphorylation microorganism says the usual dephosphorylation microorganism of the waste-water-treatment field, Acinetobacter (Acinetobacter) is mentioned as an example of the microorganism most generally known in it.

[0044] The processed material which flowed out of the aerator 8 flows into the denitrification tub 9. In the denitrification tub 9, the transplanted denitrification acid bacteria (Denitrifier) convert the nitrate nitrogen oxide contained in a processed material like NO3-->NO2-->NO->N2 O->N2 using the unsettled organic substance contained in the processed material, and nitrogen is removed. Such a denitrification reaction can use the acetic acid which is an external carbon source, a citric acid, a methanol, etc. as an electron donor depending on the case, and can raise the effectiveness of a denitrification reaction. However, it is desirable to make the point that equipment special for supply of an external carbon source is required, and the denitrification reaction using endoecism breathing (endogenous respiration) which uses a processed material and the carbon in a sludge, without supplying a carbon source from the exterior in this down stream processing in consideration of economical efficiency cause.

[0045] Furthermore, the precipitate sludge of the setting tank 10 lower part is transported to the anaerobic fermenter 5 which carries out anaerobiotic fermentation of the sludge and produces an organic acid (the path A of drawing 1), the second denitrification is advanced to it, and a perfect nitrogen removal process is built.

[0046] As for the denitrification tub 9, it is desirable to constitute so that a processed material may flow into the bottom, to increase the opportunity of contact with a processed material and a microorganism, and to make it mixed completely. Furthermore, it is desirable to install the mechanical agitator 19 for mixing so that contact of a microorganism and a processed material may be made smooth and degassing of the N2 gas which occurred with denitrifying bacteria may be well carried out from a microorganism.

[0047] The processed material processed by the denitrification tub 9 flows into a setting tank 10. In a setting tank 10, solid liquid separation of the sludge is carried out to a processed material. A setting tank 10 is the interior, and while a microorganism heavier than a processing object sediments with gravity, it is desirable to make it structure which is separated automatically. It is desirable to establish an inclination in the interior of a setting tank 10 for smooth collection of the sludge which precipitated. A part is

transported to the biotechnology pound 7 through the path E of drawing 1 , the collected precipitate sludge is transported to the anaerobic fermenter 5 through the path A of drawing 1 , and through the path D of drawing 1 , the waste sludge of an amount which was not used for the migration for MLSS maintenance of an aerator 8 is transported to a dehydrator 12, and is disposed of.

[0048] The processed material which flowed out of the setting tank 10 flows into the coagulation sedimentation tub 11. With a flocculant, the processed material which flowed into the coagulation sedimentation tub 11 is processed, and Lynn which remains, a suspended solid, and some organic substance are made to condense completely, and it processes them. According to a processor, various selections are possible for the flocculant used, and ferric chloride is used typically. The amount used can also be appropriately adjusted by the criteria of the water quality to discharge. The condensed sludge precipitates with gravity, through the path G of drawing 1 , is sent to a dehydrator 12 and disposed of. The supernatant liquor of a coagulation sedimentation tub serves as the last final effluent 13.

[0049] Moisture is separated from a sludge, and various kinds of sludges (the sludge of the chemical solid-liquid-separation tub 3, the sludge of the anaerobic fermenter 5, the waste sludge of a setting tank 10, sludge of the coagulation sedimentation tub 11) which flowed into the dehydrator are discharged by mechanical force, such as a pressure and a centrifugal force, with the gestalt of the cake 14 with which water content decreased sharply, and are used for solid composting etc. according to it. The supernatant liquor separated from the sludge is transported and reworked by the aerator 8 through the path H of drawing 1 .

[0050]

[Example] The predominance of the waste-water-treatment process of this invention is proved by a following example and the following example of a comparison.

[0051] The semantics of the abbreviated name used in the following example of a trial and the following example of a comparison is as follows.

COD (Chemical Oxygen Demand): Mean chemical oxygen demand. The chemical oxygen demand which measured the chemical oxygen demand measured as an oxidizer using the potassium dichromate ($K2Cr$ $2O7$) as CODcr and an oxidizer using potassium permanganate ($KMnO4$) is expressed as CODmn.

BOD(Biological Oxygen Demand): Biological oxygen demand TSS (Total Suspended Solids): It is the quality of a solid which contains an inorganic substance and the organic substance as a suspended solid, and say the suspended solid which is not filtered depending on a 0.1-micrometer filter paper. Usually, it is called SS, and it is also called TSS when classifying with VSS. That is, it is TSS which is called SS in the field of environmental engineering. Measurement measures the weight of the residual matter as for which the suspended solid filtered through the 0.1-micrometer filter paper evaporated moisture in 105-degree C oven, and expresses it with the weight mg of a mg/L unit, i.e., the suspended solid per 1l. of liquids.

[0052] TKN (Total Kjeldhal Nitrogen): Mean the sum of the concentration of the organic nitrogen in waste water, and ammoniacal nitrogen.

T-N (Total Nitrogen): Express the amount of total nitrogen in waste water. That is, it is the value by which organic nitrogen and inorganic nature nitrogen (the nitrogen of the gestalt of $NH4+$, $NO2-$, and $NO3-$ is included) were set.

T-P (Total phosphorus): It is the value with which fusibility Lynn which exists in waste water, and non-fusibility Lynn were doubled.

[0053] The waste-water-treatment process of <example> drawing 1 was manufactured with the reactor of a laboratory scale, and it experimented by extracting raw water in the zootechnics waste water common disposal plant. The equipment and specification of a reaction vessel of the waste-water-treatment process used for this experiment were summarized in the following table 1.

[0054]

[Table 1]

表1

反応器および機器	規格	備考
嫌気性発酵槽	容積9.0L（内径18cm，高さ45cm）	円筒形、消化スラッジ形式、30℃
アナモックス槽	容積6.0L（内径18cm，高さ33cm）	円筒形、消化スラッジ形式、30℃
電気コイルおよび制御器	600W	温度維持用
バイオボンド	容積0.45L（内径8cm，高さ18cm）	円筒形、バイオコンプ12g
曝気槽	容積37.5L（長さ44.0cm，幅20.3cm，高さ57cm）	断面長方形
脱窒槽	1.5L（内径10cm，高さ30cm）	円筒形
沈殿槽	1.5L（内径18cm，高さ30cm）	円錐型、ホッパー傾斜60°
ｐＨメーター	Accumet（登録商標）25（Fisher Co. Ltd. 商品名）	pH，ＯＲＰ，温度測定
移送ポンプ	ﾏｽﾀｰﾌﾚｯｸｽ ｺﾝｿｰﾙ駆動（Cole Parmer Instrument 社商品名）	２ヘッド
混合用撹拌機	Ｍ６１Ａ６Ｇ４Ｙ（松下電器株式会社商品名）	60 rpm
塩化第二鉄	$FeCl_3$	凝集剤
ブロアー	SPP-200GJ-H（Takatsuki Korea 社商品名）	容量210L/min

[0055] Among various kinds of equipments used in said experiment, in order to measure pH and ORP (Oxidation Reduction Potential), such as an aerator, an anaerobic fermenter, an ANAMOKKUSU tub, and a denitrification tub, the pH meter was used. The blower was used in order to supply air to an aerator and a biotechnology pound. Supply of raw water was poured in equally [5 times per] day using the transfer pump, and migration of the processed material in each reaction vessel has arranged the reactor so that it may be transported by gravity flow.

[0056]

[Table 2]

表2

区分	CODcr	BOD	TSS	TKN/NH_3	硝酸性窒素*	T-P
原水	54,000	19,000	27,500	4,500/2,900	-	830
固液分離槽流出物	32,000	12,000	8,000	3,900/2,400	-	400
ストリッピング流出物	27,000	9,900	8,000	2,500/1,400	-	360
嫌気性発酵流出物	22,800	7,700	13,500	1,440/350	-	350
アナモックス槽流出物	20,700	7,500	10,500	950/120	1.8	330
沈殿槽流出物	1,050	65	210	85/19	15	68
凝集沈殿流出物	330	30	29	16/8.5	14	5.8

単位 : mg/L

* : NO_3^-の形態で存在する窒素の量

[0057] The value of the experimental result summarized in Table 2 is the average of a laboratory operation term throughout. What was directly extracted as raw water in the Kyonggi-do Y disposal plant which is a zootechnics waste water common disposal plant was used. This was analyzed, the chemical solid liquid separation and the stripping which are pretreatment were performed at once, and the sample was kept in the 4-degree C refrigerator, and from the anaerobic fermenter, it poured in with the metering pump and experimented. The water quality of treated water obtained the very good result with which are satisfied of the water quality of feces and urine or a zootechnics waste water common disposal plant final effluent. namely, the law which BOD is 300 mg/L, SSs are 29 mg/L, T-N calls 60 or less mg/L, and T-P calls 8 or less mg/L -- criteria were satisfied.
[0058] The <example of comparison> table 3 shows the result of having performed waste water treatment by the conventional waste-water-treatment approach shown in drawing 3 . The waste-water-treatment approach of drawing 3 is an art adopted in the **** zootechnics waste-water-treatment facility design report designed in the environment management public corporation in 1997, and is an art using a liquefied corrosion tub unlike the approach of this invention.
[0059]
[Table 3]

表3

区分	CODmn	BOD	SS	T-N	T-P
原水	10,000	18,000	10,000	3,000	80
貯留槽流出物	4,952	6,830	1,353	2,032	80.4
最終放流水	296	199	184	296	15

単位 : mg/L

[0060] If the BOD value of Table 2 and Table 3 is compared, in the case of this invention, the BOD values of the final effluent discharged from the condensation tub are 30 mg/L, and are very small. It is the numeric value which the BOD values in the case of the last final effluent of Table 3 are 199 mg/L, and exceeds 6 times of this invention to it. Therefore, the final effluent by which waste water treatment was carried out was further sent to the sewage disposal plant, and discharge in a river has already been possible as it

was shown in the flow conceptual diagram of drawing 3 , in order to satisfy the permissible level value of BOD in the case of the art of drawing 3 for the first time through one processing.

[0061] As compared with the detail, it was proved in the above experimental result that the waste-water-treatment process of this invention is the treatment facility in which the removal effectiveness of an organic substance and the removal effectiveness of a nutrient were very excellent.

[0062]

[Effect of the Invention] The waste-water-treatment approach and treatment facility by this invention are the outstanding art and outstanding treatment facility which processing of the efficient organic substance of the feces and urine which are high-concentration organic waste water, or zootechnics waste water, and the nitrogen and Lynn which are a nutrient can process in ****. That is, even if it accepts influent with high suspended solid concentration by this invention, by maintaining the concentration of the suspended solid in the effluent to 10,000 - 20,000 mg-L by the chemical solid-liquid-separation tub, the MLSS concentration of an aerator is maintainable proper, operation of the whole facility is easy and it is possible to secure the stable water quality of a final effluent.

[0063] Furthermore, since nitrogen is removed by making the nitrogen nitrified with the aerator react with ammonia by the ANAMOKKUSU tub after volatilizing ammonia by the ammonia stripping tub even if it receives zootechnics waste water with high T-N concentration, stable denitrification can be performed.

[0064] This invention expands the range of zootechnics waste water etc. which can be processed more greatly than a conventional method by combining stable operation of the aerator by using such a chemical solid-liquid-separation tub, and removal of the nitrogen by the ammonia stripping tub and the ANAMOKKUSU tub.

[0065] Since smooth processing of feces and urine and zootechnics waste water can be secured by this invention, the management of the stable stock raising industry is possible, without being able to cancel the economical difficulty of a dairy farmer and inflicting damage on a circumference farmhouse. Furthermore, since the processing of feces and urine and zootechnics waste water considered as the main causes of the water pollution of a small river and a lake is solved, improvement in an environment is also expected that a big role is played.

PRIOR ART

[The technique in which invention belongs] This invention relates to the waste-water-treatment approach for processing organic waste water, such as high-concentration feces and urine or zootechnics waste water with many nitrogen components and the Lynn components. Especially this invention relates to the waste-water-treatment approach of feces and urine with the high nitrogen and Lynn concentration which are characterized by including an ANAMOKKUSU process and a biotechnology pound process, or zootechnics waste water.

EFFECT OF THE INVENTION

[Effect of the Invention] The waste-water-treatment approach and treatment facility by this invention are the outstanding art and outstanding treatment facility which processing of the efficient organic substance of the feces and urine which are high-concentration organic waste water, or zootechnics waste water, and the nitrogen and Lynn which are a nutrient can process in ****. That is, even if it accepts influent with high suspended solid concentration by this invention, by maintaining the concentration of the suspended solid in the effluent to 10,000 - 20,000 mg-L by the chemical solid-liquid-separation tub, the MLSS concentration of an aerator is maintainable proper, operation of the whole facility is easy and it is possible to secure the stable water quality of a final effluent.
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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] The purpose of this invention is offering the waste-water-treatment approach and equipment which can process effectively organic waste water, such as high-concentration difficulty resolvability zootechnics waste water with a high nitrogen content, and feces and urine.

MEANS

[Means for Solving the Problem] In order to attain the aforementioned purpose, this invention offers the new waste-water-treatment approach which combined the ANAMOKKUSU process and the biotechnology pound process. Furthermore, a solid-liquid-separation process is used for the approach of this invention instead of diluting waste water.
[0011] That is, this invention is an equalization process which equates the concentration and the flow rate of the feces and urine of (a) high concentration, or zootechnics waste

water.;
(b) the waste water equated at the aforementioned (a) process -- a flocculant -- in addition, solid-liquid-separation process; which adjusts the concentration of the organic substance, and the concentration of nitrogen to a desired level
(c) Ammonia stripping process which removes only ammoniacal nitrogen alternatively, without changing the concentration of the organic substance in the processed material by which solid liquid separation was carried out at the aforementioned (b) process;
(d) Anaerobiotic fermentation process which ferments the sludge which considered as the gestalt in which the aerobic bacteria in a consecutive process tend to take in the difficulty resolvability organic substance in the processed material processed at the aforementioned (c) process by decomposing using an anaerobic microorganism, and was transported from the following (i) process, and makes an organic acid generate;
(e) ANAMOKKUSU process which makes the nitrite nitrogen (NO2-) contained in the sludge given to anaerobiotic fermentation after being transported to the aforementioned (d) process from the following (i) process, and the ammonia contained in waste water react, and generates nitrogen gas;
(f) Microorganism activation process which exists in a biotechnology pound and which activates the solidified soil microbe;
(g) Denitrification induction type aeration process of mixing and performing denitrification after supplying the soil microbe activated at the aforementioned (f) process in a denitrification induction type aerator, disassembling the organic substance in the processed material processed at the aforementioned (e) process using the aerobic bacteria under habitation in a denitrification induction type aerator with this microorganism and nitrifying ammoniacal nitrogen to a nitrate nitrogen (NO3-);
(h) Denitrification process which returns the nitrate nitrogen in the processed material processed at the aforementioned (g) process using endoecism breathing of a microorganism in the state of anoxia to nitrogen;
(i) From the supernatant liquor which separated precipitate from the processed material and the mixture of a microorganism which were obtained at the (h) process at precipitate process; and the (j) aforementioned (i) process of carrying out solid liquid separation and transporting a part of sludge which precipitated to said anaerobiotic fermentation process (d), condensation removes the residual matter and the waste-water-treatment approach including the coagulation-sedimentation process discharged as final-treatment water is offered.
[0012] Such a waste-water-treatment approach of this invention is an equalization tub which equates the concentration and the flow rate of the following feces and urine of equipment:(A) high concentration, or zootechnics waste water.;
(B) Chemical solid-liquid-separation tub which adjusts the concentration of the organic substance of waste water and the concentration of nitrogen which flowed from said equal tub to the level for which adds a flocculant and it asks;
(C) Ammonia stripping tub which removes only ammoniacal nitrogen alternatively, without changing the concentration of the organic substance in the processed material by which solid liquid separation was carried out;
(D) Anaerobic fermenter which it considers [fermenter] as the gestalt in which the aerobic bacteria in a consecutive process tend to take in the difficulty resolvability organic substance in the processed material supplied from said stripping tub by

decomposing using an anaerobic microorganism, ferments the sludge transported from the setting tank, and makes an organic acid generate;
(E) ANAMOKKUSU tub which the nitrogen (NO2-) nitrous-acid-ized with the denitrification induction type aerator and the ammonia in a processed material react, and forms nitrogen gas;
(F) Biotechnology pound which it is equipped with the solidified soil microbe, activates this microorganism, and supplies said microorganism to a denitrification induction type aerator;
(G) Denitrification induction type aerator which performs denitrification after disassembling the organic substance in a processed material and nitrifying ammoniacal nitrogen to a nitrate nitrogen (NO3-) using the soil microbe activated in said biotechnology pound, and the aerobic bacteria under habitation to the interior of self;
(H) Denitrification tub which returns the nitrate nitrogen in the processed material which guided endoecism breathing of a microorganism in the state of anoxia, and was processed with said denitrification induction type aerator to nitrogen;
(I) Setting tank which the organic substance almost oxidizes and carries out solid liquid separation of the denitrification-ized processed material and the microorganism;
(J) coagulation sedimentation tub; which makes the residual matter condense from the supernatant liquor which carried out precipitate separation by said setting tank, and (K) -- it is performed by the equipment for waste water treatment containing the dehydration tack from which the part or all the moisture of the sludge discharged from said solid-liquid-separation tub, the anaerobic fermenter, the setting tank, and the coagulation sedimentation tub are removed.
[0013] Said waste-water-treatment approach of this invention and the 1st description of equipment are carrying out solid liquid separation through a chemical solid-liquid-separation tub instead of diluting the concentration of suspended matter with the high concentration of the organic substance to the proper level.
[0014] The 2nd description of this invention is that the concentration of the organic substance in waste water contains the ammonia stripping tub which can remove alternatively only the ammonia which is a nitrogen component, without making it change.
[0015] The 3rd description of this invention is that the anaerobic fermenter which a precipitate sludge is fermented with an anaerobic fermenter, is made to generate an organic acid, and utilizes this organic acid for removal of Lynn is included.
[0016] The 4th description of this invention is that the ANAMOKKUSU tub which transports the supernatant liquor of a setting tank, oxidizes NH4+ in waste water by NO2-, and generates nitrogen gas is included.
[0017] The 5th description of this invention is that the biotechnology pound which is filled up with the biotechnology comp which solidified the soil microbe, equips with a biotechnology manufacturer, activates a microorganism, promotes the activity of consecutive aerobic bacteria, and raises processing effectiveness is included. Here, a biotechnology pound means the structure which consists of a biotechnology manufacturer, a diffuser, etc., a biotechnology manufacturer says the microorganism activation equipment containing biotechnology comp and a crushed stone layer, and biotechnology comp means the microorganism fixed object which made the soil microbe fix.
[0018] The 6th description of this invention is that the biotechnology pound which makes

intake capacity of the organic substance the maximum with a denitrification induction type aerator is included by intercepting the inflow of the raw water to a biotechnology pound, and carrying out fixed period hunger of the microorganism.

[0019] The 7th description of this invention is that the denitrification induction type multistage aerator which does not supply air to the partition of the end of an aerator, but equips it with the agitator for mixing, and has the partition classified so that denitrification in an aerator and denitrification by the consecutive denitrification tub might be promoted and which was preferably classified into at least four steps is included. By this, mixing of a microorganism and a processed material and accommodation of the amount of dissolved oxygen become smooth, and economical operation of waste water treatment equipment is attained.

[0020] The 8th description of this invention is that the setting tank which supplies the precipitate sludge of a setting tank to a biotechnology pound, promotes the activity of a microorganism, transports supernatant liquor to an ANAMOKKUSU tub, and removes nitrogen is included.

[0021] The 9th description of this invention is that process with a flocculant the organic substance, nutrient, and suspended solid which remain in a processed material, and the coagulation sedimentation tub which can process stable and efficient water quality is included.

[0022]

[Embodiment of the Invention] Below, with reference to the block diagram and the example of a trial of a waste-water-treatment process which were shown in the attached drawing, this invention is explained further at a detail.

[0023] Drawing 1 is a flow chart which shows the example of representation of high-concentration feces and urine or down stream processing of zootechnics waste water by this invention. Waste water treatment equipment 1 is equipment which processes high-concentration feces and urine and zootechnics waste water, and is constituted as follows.

[0024] The description of zootechnics waste water changes with time amount, seasonal factors, etc. fairly [the flow rate and concentration] sharply. The equal tub 2 equates the flow rate and concentration of waste water with sharp fluctuation in this way. The suspended solid and organic nitrogen in waste water are processed with flocculants, such as ferric chloride, and it is made to become the concentration which suited consecutive processing in the chemical solid-liquid-separation tub 3. Among the nitrogen component which exists in waste water, NH3 will come to vaporize in atmospheric air, if air is puffed out. In the ammonia stripping tub 4, supply of air removes only ammoniacal nitrogen without loss of an organic substance alternatively by such principle.

[0025] The anaerobic fermenter 5 hydrolyzes the difficulty resolvability organic substance in the state of an anaerobiosis among the flowing processed material using an anaerobic microorganism, ferments the sludge transported from the setting tank 10, and generates an organic acid. In the ANAMOKKUSU tub 6, NO2- (generated by an aerator 8, especially the denitrification induction type multistage aerator) reacts with NH4+ in the state of an anaerobiosis, and generates N2 gas, and in atmospheric air, this nitrogen gas vaporizes and is removed.

[0026] The biotechnology pound 7 activates the solidified soil microbe, and supplies an aerator 8 and a microorganism especially applicable to a denitrification induction type multistage aerator. It activates in said biotechnology pound 7, and the organic substance

is oxidized not only using the supplied microorganism but using the oxygen supplied continuously, and aerobic bacteria, such as a microorganism which nitrifies ammoniacal nitrogen, are carrying out the abundant activity at this aerator 8. In the denitrification tub 9, nitrogen gasification is carried out in the state of anoxia, and the nitrified nitrogen vaporizes to atmospheric air.

[0027] Solid liquid separation of the processed material and microorganism which were processed by the anaerobic fermenter 5, the aerator 8, and the denitrification tub 9 is carried out by gravity by the setting tank 10. Finally the residual suspended solid which remains in a processed material, Lynn, and an organic substance are processed in the coagulation sedimentation tub 11 using a chemical. In this waste water treatment equipment, when the sludge generated in the chemical solid-liquid-separation tub 3, the anaerobic fermenter 5, the setting tank 10, and the coagulation sedimentation tub 11 passes through a dehydrator 12, the moisture content decreases. the supernatant water of the coagulation sedimentation tub 11 carries out the last discharge as a final effluent 13 -- having -- dehydration of a dehydrator 12 -- a cake 14 is sent to a compost shed, and it is used for manufacture of a compost or it is given to a landfill.

[0028] In this waste water treatment equipment 1, the moving trucking of a sludge is also very important with the moving trucking of a processed material. The moving trucking of the sludge in this invention is as having expressed with the dotted line to drawing 1 . If it explains concretely, the precipitate sludge by which solid liquid separation was carried out by the setting tank 10 will move to the anaerobic fermentation tub 5 through Path A, will generate an organic acid by anaerobiotic fermentation there, and will play the role which maintains the MLSS (suspended solid in mixed liquor) concentration of the denitrification induction type multistage aerator 8. An excessive waste sludge unnecessary to maintenance of the MLSS concentration of an aerator 8 is transported to a dehydrator 12 through Path D. Furthermore, the precipitate sludge of a setting tank 10 is transported also to the biotechnology pound 7 through Path C. On the other hand, the supernatant water of a setting tank 10 is transported to the ANAMOKKUSU tub 6 through Path B. The precipitate sludge of the coagulation sedimentation tub 11 is transported to a dehydrator 12 through Path G. The precipitate sludge of the chemical solid-liquid-separation tub 3 is transported to a dehydrator 12 through Path F, and the sludge of the remainder of the anaerobic fermentation tub 5 is transported to a dehydrator 12 through Path E. furthermore, dehydration generated with a dehydrator 12 -- a cake should be used as a compost, or a landfill should be carried out, and supernatant liquor should pass Path H -- an aerator 8 -- desirable -- a denitrification induction type multistage aerator -- it is especially transported to a four-step aerator preferably. Hereafter, unless it refuses especially about the structure, a denitrification induction type multistage aerator is only pointed out by name called an aerator 8.

[0029] It will be as follows if roles, such as each reaction vessel, and operation in the waste water treatment equipment 1 of this invention are further explained to a detail.

[0030] Feces and urine and zootechnics waste water which are a processed material express very various generating aspects. An yield and generating concentration are very various by the source location, the seasonal factor, time amount, etc. Thus, it is indispensable to make concentration and a flow rate into homogeneity first, in order to process the intense waste water of the range of fluctuation in order to process consecutiveness smoothly. The equalization tub 2 plays the role which equates the

amount and concentration of the waste water irregularly discharged from a generating part. Two to 3 times are suitable for the size of an equal tub on the basis of a mean daily discharge. Since generating of an odor is an intense part, an equal tub can send a part of sludge of a setting tank 10 to an equal tub depending on the need, and can also reduce generating of an odor (not shown).

[0031] The processed material equated by the equal tub is transported to the chemical solid-liquid-separation tub 3. Since the concentration of a suspended solid and an organic substance is high, for efficient processing, the transported processed material is this separation tub, and pretreats using a chemical, for example, a flocculant like a ferric chloride. It is very difficult to maintain the amount of MLSS(s) of an aerator 8 appropriately especially, since the concentration of an organic substance is high on a property for zootechnics waste water and there are many suspended solids moreover discharged from ** of stools and feed. In order to solve such a problem, in the chemical solid-liquid-separation tub 3, a little flocculant is added to the processed material which passed through the equal tub 2, and with some organic substance, a suspended solid and organic nitrogen are settled and it removes. As a flocculant, anionic, a cationic polymer, or a ferric chloride can be used according to the description of waste water. Thus, the produced precipitate sludge is transported to a dehydrator 12 through the path F of drawing 1 , and, finally dehydration processing is carried out.

[0032] In the processed material removed in the precipitate sludge, quite a lot of nitrogen components are contained compared with an organic substance by the chemical solid-liquid-separation tub 3. This generates lack of an organic substance in consecutive down stream processing, and makes efficient processing difficult. Therefore, in order to remove alternatively the ammoniacal nitrogen which occupies 60 - 70% in a nitrogen component without making an organic substance lose, a processed material is sent to the ammonia stripping tub 4.

[0033]

[Formula 1]

$$NH_3 + H_2O \rightleftarrows NH_4^+ + OH^-$$

[0034] Although ammoniacal nitrogen is maintaining equilibrium like an upper type, if pH of waste water increases to 7.0 or more, a balance will move to left-hand side and NH4+ ion will be converted into NH3. This NH3 will vaporize in atmospheric air, if waste water is stirred. By the ammonia stripping tub 4, supply of air removes the ammoniacal nitrogen in zootechnics waste water using the point (pH 9-9.5) that such a principle and pH of the zootechnics waste water itself are high.

[0035] The processed material removed in ammoniacal nitrogen by the ammonia stripping tub 4 flows into the anaerobic fermenter 5. In the anaerobic fermenter 5, it decomposes using an anaerobic microorganism and the difficulty resolvability organic substance contained in the processed material is made into the gestalt which aerobic bacteria tend to take in in a consecutive process. to the anaerobic fermenter 5, temperature is uniformly maintainable at about 30 degrees C -- as -- warming -- it is desirable to install a facility. By this, the fall of the nitrogen removal effectiveness by the temperature fall of winter can be prevented, and the smooth activity of an anaerobic microorganism can be secured. Furthermore, to the anaerobic fermenter 5, it is desirable to install the agitator 16 for mixing so that the gas (for example, CH4, CO2, H2, H2S,

etc.) which an anaerobic microorganism is smoothly mixed with a processed material in the case of the inflow of an anaerobic microorganism, makes, and occurs can be smoothly desorbed from a microorganism.

[0036] Furthermore, the sludge of the lower part of the anaerobic fermenter 5 is extracted periodically, and is transported and processed to a dehydrator 12 through the path E of drawing 1 . The anaerobic fermenter 5 carries out anaerobiotic fermentation of the sludge transported from the setting tank 10, makes organic acids, such as an acetic acid, a propionic acid, ****, a valeric acid, and a capric acid, form, and activates the dephosphorylation microorganism contained in the sludge in the state of the anaerobiosis of the anaerobic fermenter 5. Activation of a dephosphorylation microorganism is performed as everyone knows in a field by [, such as control of suitable temperature, pH, the residence time, concentration, and the interfering substance,] preparing a surrounding environment so that growth of a dephosphorylation microorganism may be suited for the time being. The activated microorganism emits microorganism intracellular Lynn (P) with the gestalt of phosphoric-acid ion (PO43-), and takes in a lot of [far] Lynn than emitted Lynn in the state of aerotropism. In this process, with the anaerobic fermenter 5, said microorganism accumulates the organic acid produced by fermentation in the inside of the body, and it is used for it as an energy source. Furthermore, the anaerobic fermenter 5 also plays the role which denitrifies secondarily the residual nitrogen by which denitrification is not carried out completely. In the anaerobic fermenter 5, it is necessary to restrict the residence time of the processed material in the interior on two - the 3rd so that it may not move from an organic-acid formation reaction to a methanogenesis reaction.

[0037] The processed material which fermented with the anaerobic fermenter 5 flows into the ANAMOKKUSU tub 6. The supernatant liquor of a setting tank 10 also flows into the ANAMOKKUSU tub 6 through the path B of drawing 1 . In the state of an anaerobiosis, nitrite ion (NO2-) or nitrate ion (NO3-) is used for an electron acceptor, CO2 is used for the only carbon source for ammonium ion (NH4+) at an electron donor, and ANAMOKKUSU (Anammox) means the process in which ammonium is oxidized in N2 gas, by the ANAMOKKUSU microorganism. Such a generalization reaction formula of an oxidation process is as follows.

[0038]

[Formula 2]

$$1NH_4^+ + 1.32NO_2^- + 0.066HCO_3^- + 0.13H^+ \xrightarrow{\text{アナモックス微生物}} 1.02N_2 + 0.26NO_3^- + 0.066CH_2O_{0.5}N_{0.15} + 2.03H_2O$$

[0039] The ANAMOKKUSU tub 6 makes nitrogen gas return the nitrite and nitrate which exist in the supernatant liquor of a setting tank 10 by the ANAMOKKUSU microorganism which exists in a processed material by such principle. warming for maintaining an ANAMOKKUSU microorganism to proper temperature, for example, 20-40 degrees C, at the ANAMOKKUSU tub 6 -- it is desirable to install a facility. The ANAMOKKUSU microorganism is mainly known as a microorganism of the Nitrosomonas (Nitrosomonas) network, and there is flexible SHIBAKUTA (Flexibacter) as a typical example (Mike S.M.Jetten et al., The anaerobic oxidation of ammonium, FEMS Microbiology Reviews 22 (1999) 421-437). Furthermore, in order to make smooth

accommodation of temperature, and mixing of a microorganism and a processed material, it is desirable to install the agitator 17 for mixing.

[0040] As for the biotechnology pound (biopond) 7, it is equipped with the biotechnology manufacturer 30 with whom the biotechnology comp (bio-comp) 40 was filled up into the interior as shown in drawing 2 . The lower part is filled up with the crushed stone layer with many mineral constituents including the biotechnology comp 40 to which the biotechnology manufacturer 30 made the upper part carry out mixed immobilization of the various microorganisms. As a crushed stone, what contains SiO230.7%, 2O312.2% of aluminum, and CaO32.5% as a principal component, for example is used. This crushed stone layer supplies an inorganic substance succeedingly in the biotechnology manufacturer 30, and activity of the microorganism of biotechnology comp is maximum-ized with this supplied inorganic substance. Biotechnology comp is the microorganism fixed object which made the bacillus (bacillus) system microorganism and the soil microbe to which actinomycetes (actinomycets) make the mainstream fix so much. The soil microbe fixed by biotechnology comp is activated by the sludge transported from the setting tank 10, and the suitable growth conditions of a microorganism formed in the biotechnology pound. First, a microorganism is activated in the state of the aerotropism formed of the air continuously supplied to the biotechnology pound 7. Time amount necessary although it activates is about two days. The activity of the microorganism in the biotechnology pound 7 is further promoted by the sludge transported from the setting tank 10. Moreover, in case this microorganism flows into an aerator 8 henceforth by not supplying sufficient food for the microorganism activated in this way (namely, thing for which raw water is not supplied to a biotechnology pound), more flourishing metabolism capacity is demonstrated.

[0041] The processed material processed by the ANAMOKKUSU tub 6 and the microorganism activated in the biotechnology pound 7 flow into the denitrification induction type aerator 8. The multistage type aerator which only stirs the last stage and does not supply air as an aerator 8 is desirable, and what has four or more steps of partitions is more desirable. This is for bringing about good nitrification and good denitrification, maintaining the change in an alkali level with sufficient balance, and preventing the inhibitory action by rapid reduction of pH by maintaining the dissolved oxygen concentration which carries out difference to smooth mixing. When the large zootechnics waste water of a concentration difference flows serially, the aerator classified into four or more steps compared with the aerator (the number of stages which supplies air is 1-2 steps) classified into 2-3 steps is easy to adjust and operate to the suitable dissolved oxygen concentration corresponding to change of pH, and can make denitrification in a denitrification layer easy by operating the last stage in the state of anoxia. Especially, since a maintenance is easy, especially a four-step aerator is desirable. When there is specifically much NO3-concentration of the treated water which flows into the 3rd step in the case of a four-step aerator, the dissolved oxygen concentration of the 1st step and the 2nd step is reduced, denitrification of NO3- is planned, when NO3-concentration is low, the dissolved oxygen concentration of the 1st step and the 2nd step can be raised, and nitrification can be advanced.

[0042] As for the case of the last stage, i.e., a four-step aerator, it is desirable by installing the agitator 19 for mixing and maintaining the amount of dissolved oxygen to 0.5 or less mg/L to make it the effectiveness of the denitrification process which is a consecutive

process become the maximum, and to carry out pH buffer action of an aerator by the increment in the alkalinity by a part of denitrification, without supplying air to the 4th step. The aerobic bacteria in an aerator 8 perform oxidation of the organic substance, nitrification, and a removal operation of Lynn by superfluous intake of Lynn through a metabolism operation. In this process, the microorganism activated in the biotechnology pound 7 achieves a more flourishing metabolism operation. Ammoniacal nitrogen is the process in which it oxidizes to NO3- through NO2-, and is this process, an alkaline substance is consumed by Nitrosomonas (Nitrosomonas) and Nitrobacter (Nitrobacter), and, as for the nitrification reaction in an aerator 8, the effectiveness that pH falls is acquired.

[0043] The phenomenon of taking in a lot of [a microorganism / when the dephosphorylation microorganism to which the removal reaction of Lynn in an aerator 8 emitted Lynn with the gestalt of a phosphoric acid with the previous anaerobic fermenter 5 compounds a cytoplasm constituent with the aerator 8 of an aerobic condition] Lynn than Lynn which the existing aerobic bacteria take in happens. This is called superfluous intake (Luxury uptake) phenomenon of Lynn. Lynn is removable by this removing the sludge by which superfluous intake was carried out. Although said dephosphorylation microorganism says the usual dephosphorylation microorganism of the waste-water-treatment field, Acinetobacter (Acinetobacter) is mentioned as an example of the microorganism most generally known in it.

[0044] The processed material which flowed out of the aerator 8 flows into the denitrification tub 9. In the denitrification tub 9, the transplanted denitrification acid bacteria (Denitrifier) convert the nitrate nitrogen oxide contained in a processed material like NO3-->NO2-->NO->N2 O->N2 using the unsettled organic substance contained in the processed material, and nitrogen is removed. Such a denitrification reaction can use the acetic acid which is an external carbon source, a citric acid, a methanol, etc. as an electron donor depending on the case, and can raise the effectiveness of a denitrification reaction. However, it is desirable to make the point that equipment special for supply of an external carbon source is required, and the denitrification reaction using endoecism breathing (endogenous respiration) which uses a processed material and the carbon in a sludge, without supplying a carbon source from the exterior in this down stream processing in consideration of economical efficiency cause.

[0045] Furthermore, the precipitate sludge of the setting tank 10 lower part is transported to the anaerobic fermenter 5 which carries out anaerobiotic fermentation of the sludge and produces an organic acid (the path A of drawing 1), the second denitrification is advanced to it, and a perfect nitrogen removal process is built.

[0046] As for the denitrification tub 9, it is desirable to constitute so that a processed material may flow into the bottom, to increase the opportunity of contact with a processed material and a microorganism, and to make it mixed completely. Furthermore, it is desirable to install the mechanical agitator 19 for mixing so that contact of a microorganism and a processed material may be made smooth and degassing of the N2 gas which occurred with denitrifying bacteria may be well carried out from a microorganism.

[0047] The processed material processed by the denitrification tub 9 flows into a setting tank 10. In a setting tank 10, solid liquid separation of the sludge is carried out to a processed material. A setting tank 10 is the interior, and while a microorganism heavier

than a processing object sediments with gravity, it is desirable to make it structure which is separated automatically. It is desirable to establish an inclination in the interior of a setting tank 10 for smooth collection of the sludge which precipitated. A part is transported to the biotechnology pound 7 through the path E of drawing 1 , the collected precipitate sludge is transported to the anaerobic fermenter 5 through the path A of drawing 1 , and through the path D of drawing 1 , the waste sludge of an amount which was not used for the migration for MLSS maintenance of an aerator 8 is transported to a dehydrator 12, and is disposed of.

[0048] The processed material which flowed out of the setting tank 10 flows into the coagulation sedimentation tub 11. With a flocculant, the processed material which flowed into the coagulation sedimentation tub 11 is processed, and Lynn which remains, a suspended solid, and some organic substance are made to condense completely, and it processes them. According to a processor, various selections are possible for the flocculant used, and ferric chloride is used typically. The amount used can also be appropriately adjusted by the criteria of the water quality to discharge. The condensed sludge precipitates with gravity, through the path G of drawing 1 , is sent to a dehydrator 12 and disposed of. The supernatant liquor of a coagulation sedimentation tub serves as the last final effluent 13.

[0049] Moisture is separated from a sludge, and various kinds of sludges (the sludge of the chemical solid-liquid-separation tub 3, the sludge of the anaerobic fermenter 5, the waste sludge of a setting tank 10, sludge of the coagulation sedimentation tub 11) which flowed into the dehydrator are discharged by mechanical force, such as a pressure and a centrifugal force, with the gestalt of the cake 14 with which water content decreased sharply, and are used for solid composting etc. according to it. The supernatant liquor separated from the sludge is transported and reworked by the aerator 8 through the path H of drawing 1 .

EXAMPLE

[Example] The predominance of the waste-water-treatment process of this invention is proved by a following example and the following example of a comparison.

[0051] The semantics of the abbreviated name used in the following example of a trial and the following example of a comparison is as follows.

COD (Chemical Oxygen Demand): Mean chemical oxygen demand. The chemical oxygen demand which measured the chemical oxygen demand measured as an oxidizer using the potassium dichromate (K2Cr 2O7) as CODcr and an oxidizer using potassium permanganate (KMnO4) is expressed as CODmn.

BOD(Biological Oxygen Demand): Biological oxygen demand TSS (Total Suspended Solids): It is the quality of a solid which contains an inorganic substance and the organic substance as a suspended solid, and say the suspended solid which is not filtered depending on a 0.1-micrometer filter paper. Usually, it is called SS, and it is also called TSS when classifying with VSS. That is, it is TSS which is called SS in the field of environmental engineering. Measurement measures the weight of the residual matter as for which the suspended solid filtered through the 0.1-micrometer filter paper evaporated moisture in 105-degree C oven, and expresses it with the weight mg of a mg/L unit, i.e.,

the suspended solid per 1l. of liquids.
[0052] TKN (Total Kjeldhal Nitrogen): Mean the sum of the concentration of the organic nitrogen in waste water, and ammoniacal nitrogen.
T-N (Total Nitrogen): Express the amount of total nitrogen in waste water. That is, it is the value by which organic nitrogen and inorganic nature nitrogen (the nitrogen of the gestalt of NH4+, NO2-, and NO3- is included) were set.
T-P (Total phosphorus): It is the value with which fusibility Lynn which exists in waste water, and non-fusibility Lynn were doubled.
[0053] The waste-water-treatment process of <example> drawing 1 was manufactured with the reactor of a laboratory scale, and it experimented by extracting raw water in the zootechnics waste water common disposal plant. The equipment and specification of a reaction vessel of the waste-water-treatment process used for this experiment were summarized in the following table 1.
[0054]
[Table 1]

表1

反応器および機器	規格	備考
嫌気性発酵槽	容積9.0L（内径18cm，高さ45cm）	円筒形、消化スラッジ形式、30℃
アナモックス槽	容積6.0L（内径18cm，高さ33cm）	円筒形、消化スラッジ形式、30℃
電気コイルおよび制御器	600W	温度維持用
バイオボンド	容積0.45L（内径8cm，高さ18cm）	円筒形、バイオコンプ12g
曝気槽	容積37.5L（長さ44.0cm，幅20.3cm，高さ57cm）	断面長方形
脱窒槽	1.5L（内径10cm，高さ30cm）	円筒形
沈殿槽	1.5L（内径18cm，高さ30cm）	円錐型、ホッパー傾斜60°
ｐＨメーター	Accumet（登録商標）25（Fisher Co. Ltd. 商品名）	pH，ＯＲＰ，温度測定
移送ポンプ	ﾏｽﾀｰﾌﾚｯｸｽ ｺﾝｿｰﾙ駆動（Cole Parmer Instrument 社商品名）	２ヘッド
混合用攪拌機	Ｍ６１Ａ６Ｇ４Ｙ（松下電器株式会社商品名）	60 rpm
塩化第二鉄	$FeCl_3$	凝集剤
ブロアー	SPP-200GJ-H（Takatsuki Korea 社商品名）	容量210L/min

[0055] Among various kinds of equipments used in said experiment, in order to measure pH and ORP (Oxidation Reduction Potential), such as an aerator, an anaerobic fermenter, an ANAMOKKUSU tub, and a denitrification tub, the pH meter was used. The blower was used in order to supply air to an aerator and a biotechnology pound. Supply of raw water was poured in equally [5 times per] day using the transfer pump, and migration of the processed material in each reaction vessel has arranged the reactor so that it may be transported by gravity flow.
[0056]
[Table 2]

表2

区分	CODcr	BOD	TSS	TKN/NH_3	硝酸性窒素*	T-P
原水	54,000	19,000	27,500	4,500/2,900	-	830
固液分離槽流出物	32,000	12,000	8,000	3,900/2,400	-	400
ストリッピング流出物	27,000	9,900	8,000	2,500/1,400	-	360
嫌気性発酵流出物	22,800	7,700	13,500	1,440/350	-	350
アナモックス槽流出物	20,700	7,500	10,500	950/120	1.8	330
沈殿槽流出物	1,050	65	210	85/19	15	68
凝集沈殿流出物	330	30	29	16/8.5	14	5.8

単位 ：mg/L

* ：NO_3^-の形態で存在する窒素の量

[0057] The value of the experimental result summarized in Table 2 is the average of a laboratory operation term throughout. What was directly extracted as raw water in the Kyonggi-do Y disposal plant which is a zootechnics waste water common disposal plant was used. This was analyzed, the chemical solid liquid separation and the stripping which are pretreatment were performed at once, and the sample was kept in the 4-degree C refrigerator, and from the anaerobic fermenter, it poured in with the metering pump and experimented. The water quality of treated water obtained the very good result with which are satisfied of the water quality of feces and urine or a zootechnics waste water common disposal plant final effluent. namely, the law which BOD is 300 mg/L, SSs are 29 mg/L, T-N calls 60 or less mg/L, and T-P calls 8 or less mg/L -- criteria were satisfied.
[0058] The <example of comparison> table 3 shows the result of having performed waste water treatment by the conventional waste-water-treatment approach shown in <u>drawing 3</u> . The waste-water-treatment approach of <u>drawing 3</u> is an art adopted in the **** zootechnics waste-water-treatment facility design report designed in the environment management public corporation in 1997, and is an art using a liquefied corrosion tub unlike the approach of this invention.
[0059]
[Table 3]

表3

区分	CODmn	BOD	SS	T-N	T-P
原水	10,000	18,000	10,000	3,000	80
貯留槽流出物	4,952	6,830	1,353	2,032	80.4
最終放流水	296	199	184	296	15

単位：mg/L

[0060] If the BOD value of Table 2 and Table 3 is compared, in the case of this invention, the BOD values of the final effluent discharged from the condensation tub are 30 mg/L, and are very small. It is the numeric value which the BOD values in the case of the last final effluent of Table 3 are 199 mg/L, and exceeds 6 times of this invention to it. Therefore, the final effluent by which waste water treatment was carried out was further sent to the sewage disposal plant, and discharge in a river has already been possible as it

was shown in the flow conceptual diagram of drawing 3 , in order to satisfy the permissible level value of BOD in the case of the art of drawing 3 for the first time through one processing.

[0061] As compared with the detail, it was proved in the above experimental result that the waste-water-treatment process of this invention is the treatment facility in which the removal effectiveness of an organic substance and the removal effectiveness of a nutrient were very excellent.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the flow chart which shows the waste-water-treatment process by this invention.

[Drawing 2] It is the detail drawing of a biotechnology pound.

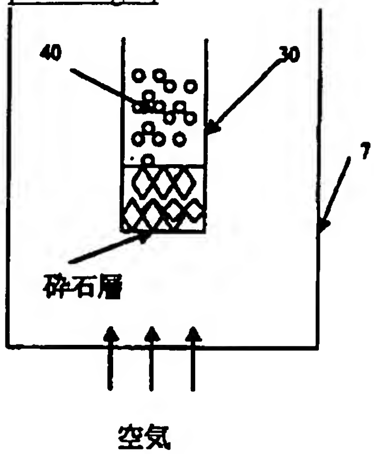
[Drawing 3] It is the flow conceptual diagram showing the conventional typical zootechnics waste-water-treatment process which uses a liquefied corrosion tub.

[Description of Notations]

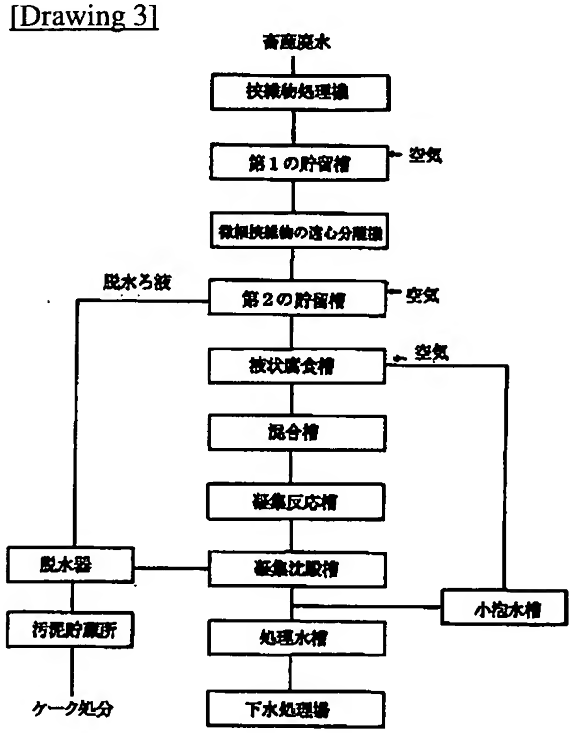
1: Waste water treatment equipment
2: Equal tub
3: Chemical solid-liquid-separation tub
4: Ammonia stripping tub
5: An anaerobic fermenter
6: ANAMOKKUSU tub
7: Biotechnology pound
8: Denitrification induction type aerator (four steps)
9: Denitrification tub
10: Setting tank
11: Coagulation sedimentation tub
12: Dehydrator
13: Final effluent
14: dehydration -- a cake
15-20: The agitator for mixing
30: Biotechnology manufacturer
40: Biotechnology comp

DRAWINGS

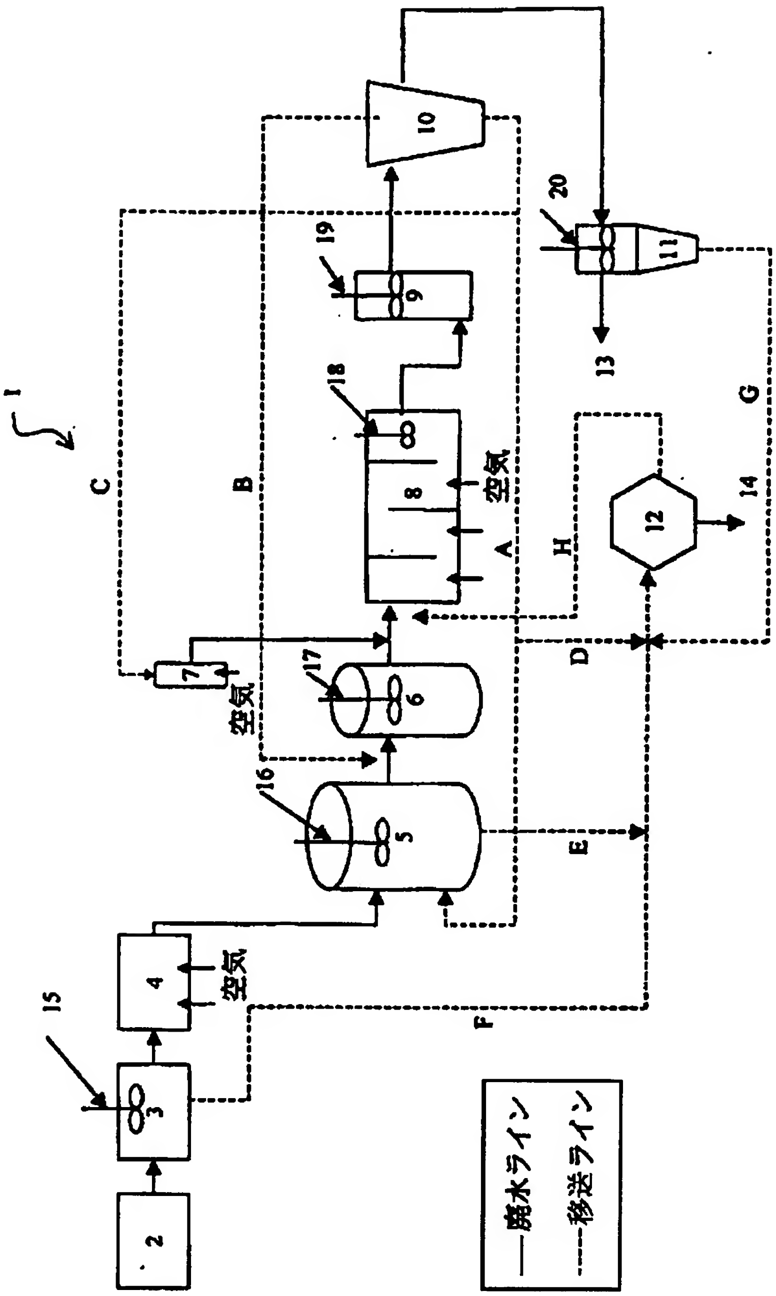
[Drawing 2]



[Drawing 3]



[Drawing 1]



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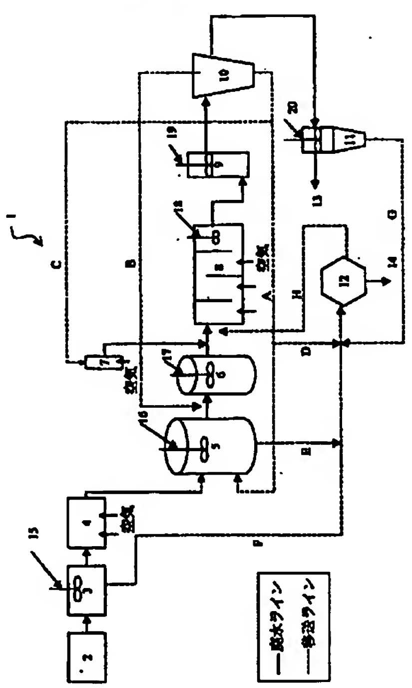
最終頁に続く

(54)【発明の名称】　バイオメーカーを用いる高濃度有機性廃水の処理方法および装置

(57)【要約】

【課題】　高濃度の難分解性畜産廃水などを効率的に処理できる廃水処理方法および装置を提供する。

【解決手段】　均等化槽、固液分離槽、アンモニアストリッピング槽、嫌気性発酵槽、アナモックス槽、バイオポンド、脱窒誘導型曝気槽、脱窒槽、沈殿槽、凝集沈殿槽および脱水槽で構成される廃水処理装置；およびそれを用いる排水処理方法。



【特許請求の範囲】
【請求項1】　(a) 高濃度の糞尿または畜産廃水の濃度と流量を均等化する均等化工程；
(b) 前記 (a) 工程で均等化された廃水に、凝集剤を加えて、有機物の濃度と窒素の濃度を、所望の水準に調整する固液分離工程；
(c) 前記 (b) 工程で固液分離された被処理物中の有機物の濃度を変化させずに、アンモニア性窒素のみを選択的に除去するアンモニアストリッピング工程；
(d) 前記 (c) 工程で処理された被処理物中の難分解性有機物を、嫌気性微生物を用いて分解することにより、後続の工程における好気性微生物が摂取し易い形態とし、かつ下記 (i) 工程から移送されたスラッジを発酵させて、有機酸を生成させる嫌気性発酵工程；
(e) 下記 (i) 工程から前記 (d) 工程に移送された後、嫌気性発酵に付されたスラッジ内に含まれる亜硝酸性窒素 (NO_2^-) と、廃水内に含まれたアンモニアを反応させて、窒素ガスを発生させるアナモックス工程；
(f) バイオポンドに存在する、固形化された土壌微生物を活性化する微生物活性化工程；
(g) 前記 (f) 工程で活性化された土壌微生物を、脱窒誘導型曝気槽内に供給し、この微生物と共に脱窒誘導型曝気槽内に棲息中の好気性微生物を用いて、前記 (e) 工程で処理された被処理物中の有機物質を分解し、アンモニア性窒素を硝酸性窒素 (NO_3^-) に硝化した後、混合して脱窒を行う脱窒誘導型曝気工程；
(h) 無酸素状態で微生物の内生呼吸を用いて、前記 (g) 工程で処理された被処理物中の硝酸性窒素を窒素に還元する脱窒工程；
(i) (h) 工程で得られた、被処理物と微生物の混合物から固液分離し、沈殿したスラッジの一部を、前記嫌気性発酵工程 (d) に移送する沈殿工程；ならびに
(j) 前記 (i) 工程で沈殿を分離した上澄液から、残余の物質を凝集によって除去し、最終処理水として放流する凝集沈殿工程を含む廃水処理方法。
【請求項2】　前記 (h) 工程において、外部から炭素源を投入しない、請求項1記載の廃水処理方法。
【請求項3】　(A) 高濃度の糞尿または畜産廃水の濃度と流量を均等化する均等化槽；
(B) 前記均等槽から流入された廃水の有機物の濃度と窒素の濃度を、凝集剤を加えて所望する水準に調整する薬品固液分離槽；
(C) 固液分離された被処理物中の有機物の濃度を変化させずに、アンモニア性窒素のみを選択的に除去するアンモニアストリッピング槽；
(D) 前記ストリッピング槽から供給された被処理物中の難分解性有機物を、嫌気性微生物を用いて分解することにより、後続の工程における好気性微生物が摂取し易い形態とし、沈殿槽から移送されたスラッジを発酵させて、有機酸を生成させる嫌気性発酵槽；
(E) 脱窒誘導型曝気槽で亜硝酸化された窒素 (NO_2^-) と、被処理物中のアンモニアが反応して、窒素ガスを形成するアナモックス槽；
(F) 固形化した土壌微生物が装着されており、これを活性化して脱窒誘導型曝気槽に前記微生物を供給するバイオポンド；
(G) 前記バイオポンドで活性化された土壌微生物、および自己内部に棲息中の好気性微生物を用いて、被処理物中の有機物質を分解し、アンモニア性窒素を硝酸性窒素 (NO_3^-) に硝化した後、脱窒を行う脱窒誘導型曝気槽；
(H) 無酸素状態で微生物の内生呼吸を誘導し、前記脱窒誘導型曝気槽で処理された被処理物中の硝酸性窒素を窒素に還元する脱窒槽；
(I) 有機物がほとんど酸化され、脱窒化された被処理物と微生物とを固液分離する沈殿槽；
(J) 前記沈殿槽で沈殿分離した上澄液から、残余の物質を凝集させる凝集沈殿槽；ならびに
(K) 前記固液分離槽、嫌気性発酵槽、沈殿槽および凝集沈殿槽から排出されたスラッジの一部または全部の水分を除去する脱水槽を含む廃水処理装置。
【請求項4】　前記脱窒誘導型曝気槽が、少なくとも4段に区分され、混合と溶存酸素量の調節ができ、最終段には、空気の供給なしに、混合用攪拌機を装着する、請求項3記載の廃水処理装置。
【発明の詳細な説明】
【0001】
【発明の属する技術】本発明は、窒素成分とリン成分が多い、高濃度の糞尿または畜産廃水などの有機性廃水を処理するための廃水処理方法に関する。特に、本発明は、アナモックス工程およびバイオポンド工程を含むことを特徴とする、窒素およびリン濃度が高い糞尿または畜産廃水の廃水処理方法に関する。
【0002】
【従来の技術】糞尿や畜産廃水の処理は非常に難しく、手間がかかる問題として認識されてきた。糞尿や畜産廃水の処理には、多様な方法が用いられているにもかかわらず、今だに、完全な処理技術として認められたものはない。糞尿や畜産廃水は、維持管理と運営の便利性を考慮して、ほとんどの場合は、1ヵ所に集めて処理する共同処理場によって処理されている。しかし、共同処理場を用いる廃水処理方式では、廃水中に存在する高濃度の有機物と、有機物質に比べてはるかに高濃度の窒素成分の処理が難しい現状である。
【0003】さらに、高濃度の糞尿や畜産廃水の処理は、大部分が希釈による処理方法であるが、このような方法は、希釈水を大量に使用せざるを得ないため、処理が非効率的である。たとえば、BODが1，5000mg/lの畜産廃水を希釈するには、該畜産廃水の75倍に相当する希釈水が必要である。それだけでなく、所要の希

積水の量により、処理施設も大規模になるため建設費用が嵩み、曝気施設および周辺機器などの費用も増加する。

【0004】糞尿または畜産廃水の現行の処理方式は、有機物の除去に重点をおいているため、現状では、湖沼の富栄養化の主要な原因物質として認められる窒素とリンの効率的な除去が行われていない。

【0005】糞尿や畜産廃水処理についての研究は、多様な工法について行われている。文献（Bortone G., Gemeli, S. および Rambaldi, A., "Nitrification, denitrification および biological phosphate removal in SBR treating piggery wastewater", Wat, Sci. Tech, Vol, No. 5-6, p977-985, 1992）には、畜産廃水の窒素除去に関連して、排出される廃水の負荷変動率について調査を行った結果、日最大流量と日平均流量との比が１．４３であり、時間あたり最小流量と最大流量の比は、８倍以上の差があったことが記載されている。

【0006】Strous, M., heijnen, J., Kuenen, J., G. および Jetten, M. S. M. "The sequencing batch reactor as a powerful tool for the study of slowly growing anaerobic ammonium-oxidizing microorganism", Appl. Microbiol. Biotechnol., Vol. 50, p589-596, 1998によれば、アナモックスを誘発する微生物の優占種は、順応するのに１年程度の期間がかかり、沈殿性に優れ、活性は２０μgN（NH_4^+形態）／(mg生物量・h)であった。またVan de Graff, A. A., Mulder, A., de Bruijn, P., Jetten, M. S. M., Robertson, L. A. および Kuenen, J. G., "Anaerobic oxidation of ammonium in a biologically mediated process", Appl. Environ. Microbiol. Vol. 61 p.1246-1251, 1995によれば、アナモックスの活性は、６６μgN（NH_4^+形態）／(mg生物量・h)であり、微生物の活性は、微量のO_2にも影響され、かつNO_3^-に絶対的に依存し、また微生物の量は、培養槽内の生物量（biomass）に直接に比例している。

【0007】Andy, S., "Ammonia volatilization from a piggery pond", Wat. Sci. Tech, Vol. 33, No. 7, p183-199, 1996には、豚舎（piggery pond）のアンモニア揮発性に対する試験を行った結果、揮発率は０．３５５〜１．５３４g/(m³·d)であって、pHにより大きい偏差を示したこと、ならびにアンモニアが揮発除去されれば、pHおよびＣＯＤが徐々に減少する傾向が表れたことが記載されている。またBicudo, J. R. および Svoboda, I. F., "Intermittent aeration of pig slurry-farm scale experiments for carbon および nitrogen removal", Wat. Sci.Tech, Vol. 32, No. 12, p83-90, 1995には、間欠曝気工程において、反応槽内の混合液浮遊固形物（Mixed Liquor Suspended Solids,MLSS）が１７，０００mg/Lの状態で運転したとき、豚舎廃水のＴ－Ｎ（Total Nitrogen）の除去効率が８６％であったことが記載されている。

【0008】本発明者らは、先に、高濃度廃水、特に畜産廃水および有機性産業廃水を、土壌微生物を利用して、経済的で効率的に処理できる廃水処理方法および装置を提供する目的で、貯留槽、嫌気性発酵槽、微生物活性化槽、混合槽、曝気槽、脱窒槽、１次沈殿槽、凝集沈殿槽および脱水機で構成される廃水処理装置；およびそれを用いる廃水処理方法を提案した（特開２０００－９３９９８号公報）。しかしながら、畜産廃水や糞尿に含まれる浮遊物質の濃度は、しばしば５０，０００〜６０，０００mg/Lのような高い値を示す。そのような場合、上記の特開２０００－９３９９８号公報に開示された方法を含めて、従来の廃水処理方法では、曝気槽のＭＬＳＳ濃度を適切に維持することが困難であった。それゆえ、このような高濃度の浮遊物質を含む流入水を受け入れても、曝気槽のＭＬＳＳ濃度を容易に維持して、廃水処理装置全体を安定に運転できる方法が求められていた。

【0009】

【発明が解決しようとする課題】本発明の目的は、窒素含有量が高い高濃度の難分解性畜産廃水や糞尿などの有機性廃水を、効率的に処理できる、廃水処理方法および装置を提供することである。

【0010】

【課題を解決するための手段】前記の目的を達成するために、本発明は、アナモックス工程とバイオボンド工程を組み合わせた、新規な廃水処理方法を提供する。さらに、本発明の方法は、廃水を希釈する代わりに、固液分離工程を使用する。

【0011】すなわち、本発明は、

（ａ）高濃度の糞尿または畜産廃水の濃度と流量を均等化する均等化工程；

（ｂ）前記（ａ）工程で均等化された廃水に凝集剤を加えて、有機物の濃度と窒素の濃度を、所望の水準に調整する固液分離工程；

（ｃ）前記（ｂ）工程で固液分離された被処理物中の有機物の濃度を変化させずに、アンモニア性窒素のみを選択的に除去するアンモニアストリッピング工程；

（ｄ）前記（ｃ）工程で処理された被処理物中の難分解性有機物を、嫌気性微生物を用いて分解することにより、後続の工程における好気性微生物が摂取し易い形態とし、かつ下記（ｉ）工程から移送されたスラッジを発酵させて、有機酸を生成させる嫌気性発酵工程；

（ｅ）下記（ｉ）工程から前記（ｄ）工程に移送された後、嫌気性発酵に付されたスラッジ内に含まれる亜硝酸性窒素（NO_2^-）と、廃水内に含まれたアンモニアを反応させて、窒素ガスを発生させるアナモックス工程；

（ｆ）バイオボンドに存在する、固形化された土壌微生物を活性化する微生物活性化工程；

（ｇ）前記（ｆ）工程で活性化された土壌微生物を、脱

窒誘導型曝気槽内に供給し、この微生物と共に脱窒誘導型曝気槽内に棲息中の好気性微生物を用いて、前記(e)工程で処理された被処理物中の有機物質を分解し、アンモニア性窒素を硝酸性窒素(NO_3^-)に硝化した後、混合して脱窒を行う脱窒誘導型曝気工程;
(h)無酸素状態で微生物の内生呼吸を用いて、前記(g)工程で処理された被処理物中の硝酸性窒素を窒素に還元する脱窒工程;
(i)(h)工程で得られた、被処理物と微生物の混合物から固液分離し、沈殿したスラッジの一部を、前記嫌気性発酵工程(d)に移送する沈殿工程;ならびに
(j)前記(i)工程で沈殿を分離した上澄液から、残余の物質を凝集によって除去し、最終処理水として放流する凝集沈殿工程を含む廃水処理方法を提供する。

【0012】このような本発明の廃水処理方法は、下記のような装置:
(A)高濃度の糞尿または畜産廃水の濃度と流量を均等化する均等化槽;
(B)前記均等槽から流入された廃水の有機物の濃度と窒素の濃度を、凝集剤を加えて所望する水準に調整する薬品固液分離槽;
(C)固液分離された被処理物中の有機物の濃度を変化させずに、アンモニア性窒素のみを選択的に除去するアンモニアストリッピング槽;
(D)前記ストリッピング槽から供給された被処理物中の難分解性有機物を、嫌気性微生物を用いて分解することにより、後続の工程における好気性微生物が摂取し易い形態とし、沈殿槽から移送されたスラッジを発酵させて、有機酸を生成させる嫌気性発酵槽;
(E)脱窒誘導型曝気槽で亜硝酸化された窒素(NO_2^-)と、被処理物中のアンモニアが反応して、窒素ガスを形成するアナモックス槽;
(F)固形化された土壌微生物が装着されており、この微生物を活性化して脱窒誘導型曝気槽に前記微生物を供給するバイオポンド;
(G)前記バイオポンドで活性化された土壌微生物、および自己内部に棲息中の好気性微生物を用いて、被処理物中の有機物質を分解し、アンモニア性窒素を硝酸性窒素(NO_3^-)に硝化した後、脱窒を行う脱窒誘導型曝気槽;
(H)無酸素状態で微生物の内生呼吸を誘導し、前記脱窒誘導型曝気槽で処理された被処理物中の硝酸性窒素を窒素に還元する脱窒槽;
(I)有機物がほとんど酸化され、脱窒化された被処理物と微生物とを固液分離する沈殿槽;
(J)前記沈殿槽で沈殿分離した上澄液から、残余の物質を凝集させる凝集沈殿槽;ならびに
(K)前記固液分離槽、嫌気性発酵槽、沈殿槽および凝集沈殿槽から排出されたスラッジの一部または全部の水分を除去する脱水槽を含む廃水処理用装置によって行われる。

【0013】本発明の前記廃水処理方法および装置の第1の特徴は、有機物の濃度が高い浮遊物の濃度を適正な水準に希釈する代わりに、薬品固液分離槽を通じて固液分離することである。

【0014】本発明の第2の特徴は、廃水中の有機物の濃度は変化させずに、窒素成分であるアンモニアのみを選択的に除去することができるアンモニアストリッピング槽を含むことである。

【0015】本発明の第3の特徴は、沈殿スラッジを、嫌気性発酵槽で発酵させて有機酸を発生させ、この有機酸をリンの除去に活用する嫌気性発酵槽を含むことである。

【0016】本発明の第4の特徴は、沈殿槽の上澄液を移送して、廃水内のNH_4^+をNO_2^-により酸化し、窒素ガスを発生する、アナモックス槽を含むことである。

【0017】本発明の第5の特徴は、土壌微生物を固形化したバイオコンプを充填してバイオメーカーを装着し、微生物を活性化して後続の好気性微生物の活性を促進し、処理効率を向上させるバイオポンドを含むことである。ここで、バイオポンドとは、バイオメーカーと散気装置などからなる構造物を言い、バイオメーカーとは、バイオコンプと砕石層を含む微生物活性化装置を言い、バイオコンプとは、土壌微生物を固定化させた微生物固定体を意味する。

【0018】本発明の第6の特徴は、バイオポンドへの原水の流入を遮断して、微生物を一定期間飢えさせることにより、脱窒誘導型曝気槽で有機物の摂取能力を極大にするバイオポンドを含むことである。

【0019】本発明の第7の特徴は、曝気槽の末端の区分には、空気の供給を行わず、混合用攪拌機を装着して、曝気槽内の脱窒と、後続の脱窒槽による脱窒を促進するように区分された区画を有する、好ましくは少なくとも4段に区分された脱窒誘導型多段曝気槽を含むことである。このことにより、微生物と被処理物の混合、および溶存酸素量の調節が円滑になり、廃水処理装置の経済的な運転が可能になる。

【0020】本発明の第8の特徴は、沈殿槽の沈殿スラッジをバイオポンドに供給して、微生物の活性を促進し、上澄液をアナモックス槽に移送して窒素を除去する沈殿槽を含むことである。

【0021】本発明の第9の特徴は、被処理物に残存する有機物と栄養素および懸濁物を、凝集剤で処理し、安定的で効率的な水質の処理が可能な凝集沈殿槽を含むことである。

【0022】

【発明の実施の形態】以下に、添付された図面に示した廃水処理工程の構成図と試験例を参照し、本発明をさらに詳細に説明する。

【0023】図1は、本発明による高濃度の糞尿や畜産

廃水の処理工程の代表例を示すフローチャートである。廃水処理装置１は、高濃度の糞尿や畜産廃水を処理する装置であり、以下のように構成される。

【００２４】畜産廃水の性状は、時間および季節的な要因などにより、その流量と濃度が相当大幅に変化する。均等槽２は、このように変動が激しい廃水の、流量と濃度を均等化する。薬品固液分離槽３では、廃水内の浮遊物質と有機性窒素を、塩化鉄などの凝集剤によって処理し、後続の処理に適合した濃度になるようにする。廃水内に存在する窒素含有成分中、NH_3は、空気を吹き入れれば大気中に揮散するようになる。アンモニアストリッピング槽４では、このような原理により、空気の供給により、有機物質の損失なしにアンモニア性窒素のみを選択的に除去する。

【００２５】嫌気性発酵槽５は、流入する被処理物中、難分解性有機物を嫌気性微生物を用いて嫌気性状態で加水分解し、沈殿槽１０から移送されたスラッジを発酵して有機酸を生成する。アナモックス槽６では、NO_2^-（曝気槽８、特に脱窒誘導型多段曝気槽で生成される）が、嫌気性状態でNH_4^+と反応してN_2ガスを生成し、この窒素ガスは大気中に揮散して除去される。

【００２６】バイオポンド７は、固形化された土壌微生物を活性化し、曝気槽８、特に脱窒誘導型多段曝気槽に適用可能な微生物を供給する。該曝気槽８には、前記バイオポンド７で活性化され、供給された微生物だけでなく、連続的に供給される酸素を用いて有機物を酸化し、アンモニア性窒素を硝化する微生物などの好気性微生物が、多量活動している。硝化された窒素は、脱窒槽９において、無酸素状態で窒素ガス化され、大気に揮散する。

【００２７】嫌気性発酵槽５、曝気槽８および脱窒槽９で処理された被処理物と微生物とは、沈殿槽１０で重力により固液分離される。被処理物に残存する残留浮遊物質、ならびにリンおよび有機物質は、凝集沈殿槽１１において、薬品を使用して最終的に処理される。本廃水処理装置において、薬品固液分離槽３、嫌気性発酵槽５、沈殿槽１０および凝集沈殿槽１１で発生したスラッジは、脱水器１２を経ることにより、その水分含量が減少する。凝集沈殿槽１１の上澄水は、放流水１３として最終放流され、脱水器１２の脱水ケーク１４は、堆肥舎に送られて堆肥の製造に用いられたり、埋立処分に付される。

【００２８】本廃水処理装置１においては、被処理物の移動経路とともに、スラッジの移動経路も非常に重要である。本発明におけるスラッジの移動経路は、図１に点線で表したとおりである。具体的に説明すれば、沈殿槽１０で固液分離された沈殿スラッジは、経路Ａを経て嫌気発酵槽５に移動し、そこで嫌気性発酵により有機酸を生成し、脱窒誘導型多段曝気槽８のＭＬＳＳ（混合液中の浮遊物質）濃度を維持する役割を果たす。曝気槽８のＭＬＳＳ濃度の維持に不要な余分の廃スラッジは、経路Ｄを経て脱水器１２に移送される。さらに、沈殿槽１０の沈殿スラッジは、経路Ｃを経てバイオポンド７にも移送される。一方、沈殿槽１０の上澄水は、経路Ｂを経てアナモックス槽６に移送される。凝集沈殿槽１１の沈殿スラッジは、経路Ｇを経て脱水器１２に移送される。薬品固液分離槽３の沈殿スラッジは、経路Ｆを経て脱水器１２に移送され、嫌気発酵槽５の剰余のスラッジは、経路Ｅを経て脱水器１２に移送される。さらに、脱水器１２で発生する脱水ケークは、堆肥として使用されるか、埋立処分され、脱離液は、経路Ｈを経て曝気槽８、好ましくは脱窒誘導型多段曝気槽、特に好ましくは４段曝気槽に移送される。以下、特にその構造についてことわらない限り、単に曝気槽８という名称で、脱窒誘導型多段曝気槽を指す。

【００２９】本発明の廃水処理装置１における、各反応槽などの役割と作用を、さらに詳細に説明すれば、以下のとおりである。

【００３０】被処理物である糞尿や畜産廃水は、非常に多様な発生様態を表す。発生場所、季節的な要因および時間などにより、発生量と発生濃度は、非常に多様である。このように変動幅の激しい廃水を処理するためには、まず濃度と流量を均一にすることが、後続の処理を円滑に行うために必須である。均等化槽２は、発生個所から不規則に排出される廃水の量と濃度を均等化する役割を果たす。均等槽のサイズは、日平均流量を基準として２～３倍が適当である。均等槽は、臭気の発生が激しい個所であるため、必要によっては、沈殿槽１０のスラッジの一部を均等槽に送って、臭気の発生を減らすこともできる（図示せず）。

【００３１】均等槽で均等化された被処理物は、薬品固液分離槽３に移送される。移送された被処理物は、浮遊物質および有機物質の濃度が高いので、効率的な処理のために、該分離槽で、薬品、たとえば塩化第二鉄のような凝集剤を使用して前処理を行う。特に、畜産廃水には、特性上、有機物質の濃度が高く、そのうえ糞と飼料の滓から排出される浮遊物質が多いので、曝気槽８のＭＬＳＳ量を適切に維持することは非常に難しい。このような問題を解決するために、薬品固液分離槽３では、均等槽２を経た被処理物に少量の凝集剤を加えて、若干の有機物とともに、浮遊物質および有機性窒素を沈殿させて除去する。凝集剤としては、廃水の性状により、アニオン性またはカチオン性重合体または塩化第二鉄を使用することができる。このようにして生じた沈殿スラッジを、図１の経路Ｆを経て脱水器１２に移送し、最終的に脱水処理する。

【００３２】薬品固液分離槽３で沈殿スラッジを除去された被処理物には、有機物質に比べてかなり多量の窒素成分を含有している。これは後続の処理工程において有機物質の不足を発生させ、効率的な処理を困難にする。

したがって、有機物質を損失させないで、窒素成分中の６０〜７０％を占めるアンモニア性窒素を選択的に除去するため、被処理物をアンモニアストリッピング槽４に送る。

【００３３】

【化１】

$$NH_3 + H_2O \rightleftarrows NH_4^+ + OH^-$$

【００３４】アンモニア性窒素は、上式のような平衡状態を維持しているが、廃水のpHが７．０以上に増加すれば、平衡は左側に移動して、NH_4^+イオンがNH_3に転換される。このNH_3は、廃水を撹拌すれば大気中に揮散する。このような原理と、畜産廃水自体のpHが高いという（pH９〜９．５）点を利用して、アンモニアストリッピング槽４では、空気の供給によって、畜産廃水中のアンモニア性窒素を除去する。

【００３５】アンモニアストリッピング槽４でアンモニア性窒素を除去された被処理物は、嫌気性発酵槽５に流入する。嫌気性発酵槽５では、被処理物に含まれた難分解性有機物を、嫌気性微生物を用いて分解して、後続の工程において好気性微生物が摂取し易い形態とする。嫌気性発酵槽５には、温度を約３０℃に一定に維持することができるように、加温施設を設置することが好ましい。このことにより、冬季の温度低下による窒素除去効率の下落を防止し、嫌気性微生物の円滑な活動を確保することができる。さらに、嫌気性微生物の流入の際に、嫌気性微生物が被処理物と円滑に混合されるようにし、発生するガス（たとえば、CH_4、CO_2、H_2、H_2Sなど）が微生物から円滑に脱離できるように、嫌気性発酵槽５には、混合用撹拌機１６を設置することが好ましい。

【００３６】さらに、嫌気性発酵槽５の下部のスラッジを、定期的に抜き出し、図１の経路Ｅを経て脱水器１２に移送して処理する。嫌気性発酵槽５は、沈殿槽１０から移送されたスラッジを嫌気性発酵して、酢酸、プロピオン酸、酪酸、吉草酸、カプリン酸などの有機酸を形成させ、スラッジ内に含有されている脱リン微生物を、嫌気性発酵槽５の嫌気性状態で活性化させる。脱リン微生物の活性化は、当分野において周知のとおり、適切な温度、pH、滞留時間、濃度、妨害物質の抑制など、周辺の環境を脱リン微生物の成長に適合するように調製することによって行われる。活性化された微生物は、微生物細胞内のリン（Ｐ）をリン酸イオン（PO_4^{3-}）の形態で放出し、放出されたリンより遥かに多量のリンを、好気性状態で摂取する。この過程において、前記微生物は、嫌気性発酵槽５で発酵によって生じた有機酸を体内に蓄積し、エネルギー源として用いる。さらに、嫌気性発酵槽５は、完全に脱窒されていない残存窒素を、二次的に脱窒する役割も果たす。嫌気性発酵槽５では、有機酸形成反応からメタン形成反応に移らないように、その内部における被処理物の滞留時間を２〜３日に制限する必要がある。

【００３７】嫌気性発酵槽５で発酵した被処理物は、アナモックス槽６に流入する。沈殿槽１０の上澄液もまた、図１の経路Ｂを経てアナモックス槽６に流入する。アナモックス（Anammox）とは、嫌気性状態でアンモニウムイオン（NH_4^+）を電子供与体に、亜硝酸イオン（NO_2^-）または硝酸イオン（NO_3^-）を電子受容体に、CO_2を唯一の炭素源に使用し、アナモックス微生物により、アンモニウムをN_2ガスに酸化させる過程を意味する。このような酸化過程の総括反応式は、下記のとおりである。

【００３８】

【化２】

$$1NH_4^+ + 1.32NO_2^- + 0.066HCO_3^- + 0.13H^+ \xrightarrow{\text{アナモックス微生物}} 1.02N_2 + 0.26NO_3^- + 0.066CH_2O_{0.5}N_{0.16} + 2.03H_2O$$

【００３９】アナモックス槽６は、このような原理により、被処理物中に存在するアナモックス微生物によって、沈殿槽１０の上澄液に存在する亜硝酸塩や硝酸塩を、窒素ガスに還元させる。アナモックス槽６には、アナモックス微生物を適正な温度、たとえば２０〜４０℃に維持するための加温施設を設置することが好ましい。アナモックス微生物は、主にニトロソモナス（Nitrosomonas）系統の微生物として知られており、代表的な例としては、フレキシバクター（Flexibacter）がある（Mike S. M. Jettenら、The anaerobic oxidation of ammonium, FEMS Microbiology Reviews 22(1999) 421-437）。さらに、温度の調節および微生物と被処理物の混合を円滑にするため、混合用撹拌機１７を設置することが好ましい。

【００４０】図２に示すように、バイオポンド（biopond）７は、内部にバイオコンプ（bio-comp）４０が充填されたバイオメーカー３０が装着されている。バイオメーカー３０は、その上部に種々の微生物を混合固定させたバイオコンプ４０を含み、その下部には、無機成分が多い砕石層が充填されている。砕石としては、たとえば$SiO_2$３０．７％、$Al_2O_3$１２．２％およびCaO３２．５％を主成分として含むものが用いられる。この砕石層は、バイオメーカー３０内に無機物を引き続き供給し、この供給された無機物により、バイオコンプの微生物の活性が極大化される。バイオコンプは、バチルス（bacillus）系微生物と放線菌類（actinomycets）が主流をなす土壌微生物を、多量に固定化させた微生物固定体である。バイオコンプに固定化された土壌微生物は、

沈殿槽１０から移送されたスラッジと、バイオボンド内に形成された適切な微生物の成長条件とによって、活性化される。まず、微生物は、バイオボンド７に継続的に供給される空気により形成された好気性状態で活性化される。活性化されるのに所要な時間は、２日程度である。バイオボンド７内の微生物の活性は、沈殿槽１０から移送されたスラッジにより、さらに促進される。また、このように活性化された微生物に充分な餌を供給しないことにより（すなわち、バイオボンドに原水を供給しないことにより）、以後、この微生物が曝気槽８に流入する際に、より旺盛な物質代謝能力を発揮する。

【００４１】アナモックス槽６で処理された被処理物と、バイオボンド７で活性化された微生物は、脱窒誘導型曝気槽８に流入する。曝気槽８としては、最終段を単に攪拌を行うだけで、空気の供給を行わない多段式曝気槽が好ましく、４段以上の区分を有するものがより好ましい。これは、円滑な混合と、相異する溶存酸素濃度を維持することにより、良好な硝化および脱窒をもたらして、アルカリ度の増減をバランスよく維持し、急激なpHの減少による阻害作用を防止するためである。２～３段に区分された曝気槽（空気を供給する段数は１～２段）に比べて、４段以上に区分された曝気槽は、濃度差の大きい畜産廃水が逐次流入するときに、pHの変化に対応する適切な溶存酸素濃度に調節して運転することが容易であり、最終段を無酸素状態で運転することにより、脱窒層における脱窒を容易にできる。中でも、維持管理が容易なことから、４段曝気槽が特に好ましい。具体的には、４段曝気槽の場合、第３段に流入する処理水のNO_3^-濃度が多い場合には、第１段および第２段の溶存酸素濃度を低下させてNO_3^-の脱窒を図り、NO_3^-濃度が低い場合には、第１段および第２段の溶存酸素濃度を高めて、硝化を進めることができる。

【００４２】最終段、すなわち、４段曝気槽の場合は第４段には、空気を供給することなく、混合用攪拌機１９を設置して、溶存酸素量を０．５mg/L以下に維持することにより、後続の工程である脱窒工程の効率が極大になるようにし、一部の脱硝によるアルカリ度の増加によって、曝気槽のpH緩衝作用をすることが好ましい。曝気槽８内における好気性微生物は、物質代謝作用を通じて有機物の酸化と、硝化およびリンの過剰摂取によるリンの除去作用を行う。この過程において、バイオボンド７で活性化された微生物が、より旺盛な物質代謝作用を果たす。曝気槽８における硝化反応は、ニトロソモナス（Nitrosomonas）とニトロバクター（Nitrobacter）により、アンモニア性窒素がNO_2^-を経てNO_3^-に酸化される過程であり、この過程で、アルカリ性物質が消費されて、pHが下がるという効果が得られる。

【００４３】曝気槽８におけるリンの除去反応は、先の嫌気性発酵槽５でリンをリン酸の形態で放出した脱リン微生物が、好気性の状態の曝気槽８で細胞質構成物質を合成するとき、既存の好気性微生物が摂取するリンより多量のリンを摂取する現象が起こる。これをリンの過剰摂取（Luxury uptake）現象という。これにより、過剰摂取されたスラッジを除去することによって、リンを除去することができる。前記脱リン微生物は、廃水処理分野の通常的な脱リン微生物をいうが、その中で、最も一般的に知られた微生物の例としては、アシネトバクター（Acinetobacter）が挙げられる。

【００４４】曝気槽８から流出した被処理物は、脱窒槽９に流入する。脱窒槽９では、移植された脱硝酸菌（Denitrifier）が、被処理物に含まれた未処理の有機物を用いて、被処理物内に含まれる硝酸性窒素酸化物を、$NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow N_2O \rightarrow N_2$のように転換し、窒素を除去する。このような脱窒反応は、場合によっては電子供与体として、外部の炭素源である酢酸、クエン酸、メタノールなどを使用し、脱窒反応の効率を高めることができる。しかし、外部の炭素源の供給のためには別途の装置が必要であるという点と、経済性を考慮して、本処理工程においては、外部から炭素源を投入することなく、被処理物とスラッジ内の炭素を使用する内生呼吸（endogenous respiration）を用いた脱窒反応を起こさせることが好ましい。

【００４５】さらに、スラッジを嫌気性発酵して有機酸を生産する嫌気性発酵槽５に、沈殿槽１０下部の沈殿スラッジを移送し（図１の経路Ａ）、第二次の脱窒を進めて、完全な窒素除去工程を構築する。

【００４６】脱窒槽９は、被処理物が下側に流入するように構成し、被処理物と微生物との接触の機会を増やして完全に混合されるようにすることが好ましい。さらに、微生物と被処理物の接触を円滑にし、脱窒菌により発生したN_2ガスが、微生物からうまく脱気されるように、機械的な混合用攪拌機１９を設置することが好ましい。

【００４７】脱窒槽９で処理された被処理物は、沈殿槽１０に流入する。沈殿槽１０では、被処理物とスラッジが固液分離される。沈殿槽１０は、その内部で、処理物より重い微生物が、重力により沈降しながら自然に分離するような構造にすることが好ましい。沈殿したスラッジの円滑な収集のために、沈殿槽１０の内部には、傾斜を設けることが好ましい。集められた沈殿スラッジは、図１の経路Ｅを経てバイオボンド７に一部が移送され、図１の経路Ａを経て嫌気性発酵槽５に移送され、曝気槽８のＭＬＳＳ維持のための移送に用いられなかった量の廃スラッジは、図１の経路Ｄを経て脱水器１２に移送されて、処分される。

【００４８】沈殿槽１０から流出した被処理物は、凝集沈殿槽１１に流入する。凝集沈殿槽１１に流入した被処理物は、凝集剤で処理し、残留するリンと懸濁固形物および一部の有機物を完全に凝集させて処理する。使用される凝集剤は、処理装置に合わせて多様な選択が可能で

あり、代表的には塩化鉄が用いられる。使用量も、放流する水質の基準により、適切に調節することができる。凝集したスラッジは、重力により沈殿し、図1の経路Gを経て脱水器12に送られて処分される。凝集沈殿槽の上澄液は、最終放流水13となる。

【0049】脱水器に流入した各種のスラッジ（薬品固液分離槽3のスラッジ、嫌気性発酵槽5のスラッジ、沈殿槽10の廃スラッジ、凝集沈殿槽11のスラッジ）は、圧力や遠心力などの機械的な力によって水分がスラッジから分離され、含水率が大幅に減少したケーク14の形態で排出されて、固形堆肥化などに利用される。スラッジから分離された脱離液は、図1の経路Hを経て曝気槽8に移送されて、再処理される。

【0050】

【実施例】本発明の廃水処理工程の優位性を、次の実施例および比較例によって立証する。

【0051】下記の試験例および比較例で使用された略称の意味は、以下のとおりである。

COD（Chemical Oxygen Demand）：化学的酸素要求量を意味する。酸化剤として重クロム酸カリウム（$K_2Cr_2O_7$）を使用して測定した化学的酸素要求量をCODcr、酸化剤として過マンガン酸カリウム（$KMnO_4$）を使用して測定した化学的酸素要求量をCODmnと表す。

BOD（Biological Oxygen Demand）：生物学的酸素要求量

TSS（Total Suspended Solids）：浮遊物質として無機物と有機物を含有する固形物質であって、0．1μmのろ紙によってはろ過されない浮遊物質をいう。通常SSと言われ、VSSと区分するときにはTSSとも言われる。すなわち、環境工学の分野でSSと言われるものは、TSSである。測定は、0．1μmのろ紙でろ過した浮遊物質を、105℃のオーブンで水分を蒸発させた残余物質の重量を測定してmg/L単位、すなわち、液体1リットル当たりの浮遊物質の重量mgで表す。

【0052】TKN（Total Kjeldhal Nitrogen）：廃水中の有機性窒素とアンモニア性窒素の濃度の和を意味する。

T−N（Total Nitrogen）：廃水中の総窒素量を表す。すなわち、有機性窒素と無機性窒素（NH_4^+、NO_2^-、NO_3^-の形態の窒素を含む）を合わせた値である。

T−P（Total phosphorus）：廃水内に存在する可溶性リンと非可溶性リンを合せた値である。

【0053】<実施例>図1の廃水処理工程を実験室規模の反応器で製作し、畜産廃水共同処理場で原水を採取して実験を実施した。下記の表1に、本実験に使用した廃水処理工程の反応槽の、装置および規格をまとめた。

【0054】

【表1】

表1

反応器および機器	規格	備考
嫌気性発酵槽	容積 9.0L（内径 18cm, 高さ 45cm）	円筒形、消化スラッジ形式、30℃
アナモックス槽	容積 6.0L（内径 18cm, 高さ 33cm）	円筒形、消化スラッジ形式、30℃
電気コイルおよび制御器	600W	温度維持用
バイオポンド	容積 0.45L（内径 8cm, 高さ 18cm）	円筒形、バイオコンプ 12 g
曝気槽	容積 37.5L（長さ 44.0cm, 幅 20.3cm, 高さ 57cm）	断面長方形
脱窒槽	1.5L（内径 10cm, 高さ 30cm）	円筒形
沈殿槽	1.5L（内径 18cm, 高さ 30cm）	円錐型、ホッパー傾斜 60°
pHメーター	Accumet（登録商標）25 (Fisher Co. Ltd. 商品名)	pH, ORP, 温度測定
移送ポンプ	ﾏｽﾀｰﾌﾚｯｸｽ ｺﾝｿｰﾙ駆動 (Cole Parmer Instrument 社商品名)	2ヘッド
混合用攪拌機	M61A6G4Y (松下電器株式会社商品名)	60 rpm
塩化第二鉄	$FeCl_3$	凝集剤
ブロアー	SPP-200GJ-H (Takatsuki Korea 社商品名)	容量 210L/min

【0055】前記実験で使用された各種の装置中、曝気槽、嫌気性発酵槽、アナモックス槽および脱窒槽などのpHとORP（Oxidation Reduction Potential）を測定するために、pHメーターを使用した。曝気槽とバイオポンドに空気を供給するために、ブロアーを使用した。原水の供給は、移送ポンプを用いて1日5回均等に注入し、各反応槽における被処理物の移動は、自然流下により移送されるように、反応器を配置した。

【0056】

【表2】

表2

区分	CODcr	BOD	TSS	TKN/NH_3	硝酸性窒素*	T-P
原水	54,000	19,000	27,500	4,500/2,900	-	830
固液分離槽流出物	32,000	12,000	8,000	3,900/2,400	-	400
ストリッピング流出物	27,000	9,900	8,000	2,500/1,400	-	360
嫌気性発酵流出物	22,800	7,700	13,500	1,440/350	-	350
アナモックス槽流出物	20,700	7,500	10,500	950/120	1.8	330
沈殿槽流出物	1,050	65	210	85/19	15	68
凝集沈殿流出物	330	30	29	16/8.5	14	5.8

単位：mg/L

*　：NO_3^-の形態で存在する窒素の量

【0057】表2でまとめた実験結果の値は、実験室運転期間中の平均値である。原水としては、畜産廃水共同処理場である京畿道Y処理場で直接採取したものを用いた。これを分析し、前処理である薬品固液分離とストリッピングを一度に行い、試料を4℃の冷蔵庫に保管して嫌気性発酵槽から定量ポンプにより注入して実験を行った。処理水の水質は、糞尿や畜産廃水共同処理場放流水の水質を満足する、非常に良好な結果を得た。すなわち、BODが300mg/L、SSが29mg/Lであり、T－Nが60mg/L以下、T－Pが8mg/L以下という法基準を満足させた。

【0058】<比較例>表3は、図3に示された従来の廃水処理方法によって廃水処理を行った結果を示す。図3の廃水処理方法は、1997年に環境管理公団で設計した漣川畜産廃水処理施設設計報告書で採択された処理方法であって、本発明の方法と異なり、液状腐食槽を用いる処理方法である。

【0059】

【表3】

表3

区分	CODmn	BOD	SS	T-N	T-P
原水	10,000	18,000	10,000	3,000	80
貯留槽流出物	4,952	6,830	1,353	2,032	80.4
最終放流水	296	199	184	296	15

単位：mg/L

【0060】表2と表3のBOD値を比較すれば、本発明の場合、凝集槽から排出した放流水のBOD値が30mg/Lであって、非常に小さい。それに対し、表3の最終放流水の場合のBOD値は199mg/Lであって、本発明の6倍を越える数値である。したがって、図3の処理方法の場合、BODの許容基準値を満足させるためには、図3の流れ概念図に示したとおり、廃水処理された放流水をさらに下水処理場に送り、もう一回の処理を経て、はじめて河川への放流が可能であった。

【0061】以上の実験結果を詳細に比較して、本発明の廃水処理工程は、有機物質の除去効率と栄養素の除去効率が非常に優れた処理施設であることが立証された。

【0062】

【発明の効果】本発明による廃水処理方法と処理施設は、高濃度の有機性廃水である糞尿や畜産廃水の効率的な有機物の処理と、栄養素である窒素とリンが効果的に処理できる、優れた処理方法および処理施設である。すなわち、本発明によって、浮遊物質濃度の高い流入水を受け入れても、薬品固液分離槽によって、その流出水中の浮遊物質の濃度を10，000～20，000mg·Lに維持することにより、曝気槽のMLSS濃度を適正に維持することができ、施設全体の運転が容易で、放流水の安定な水質を確保することが可能である。

【0063】さらに、T－N濃度の高い畜産廃水を受け入れても、アンモニアストリッピング槽でアンモニアを揮発させた後に、曝気槽で硝化された窒素をアナモックス槽でアンモニアと反応させることにより、窒素を除去するので、安定した脱窒を行うことができる。

【0064】本発明は、このような、薬品固液分離槽を用いることによる曝気槽の安定な運転と、アンモニアストリッピング槽およびアナモックス槽による窒素の除去とを組み合わせることにより、畜産廃水などの処理可能な範囲を、従来法より大きく拡大したものである。

【0065】本発明によって糞尿や畜産廃水の円滑な処理が保障できるため、畜産農家の経済的な困難さが解消でき、周辺農家に被害を与えずに安定的な畜産業の経営が可能である。さらに、小河川および湖の水質汚染の主要な原因とされてきた糞尿や畜産廃水の処理が解決する

ので、環境の向上にも大きな役割を果たすものと期待される。

【図面の簡単な説明】

【図1】本発明による廃水処理工程を示すフローチャートである。

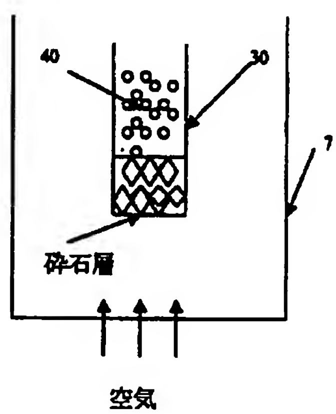
【図2】バイオボンドの詳細図である。

【図3】液状腐食槽を使用する従来の代表的な畜産廃水処理工程を示す流れ概念図である。

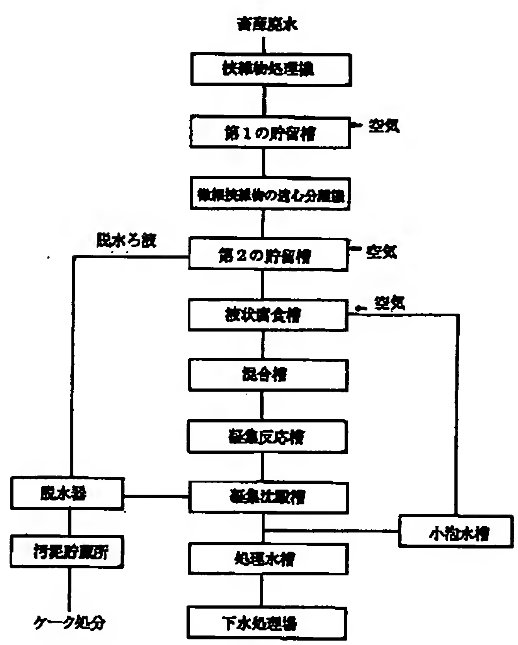
【符号の説明】

1：廃水処理装置
2：均等槽
3：薬品固液分離槽
4：アンモニアストリッピング槽
5：嫌気性発酵槽
6：アナモックス槽
7：バイオボンド
8：脱窒誘導型曝気槽（４段）
9：脱窒槽
10：沈殿槽
11：凝集沈殿槽
12：脱水器
13：放流水
14：脱水ケーク
15～20：混合用攪拌機
30：バイオメーカー
40：バイオコンプ

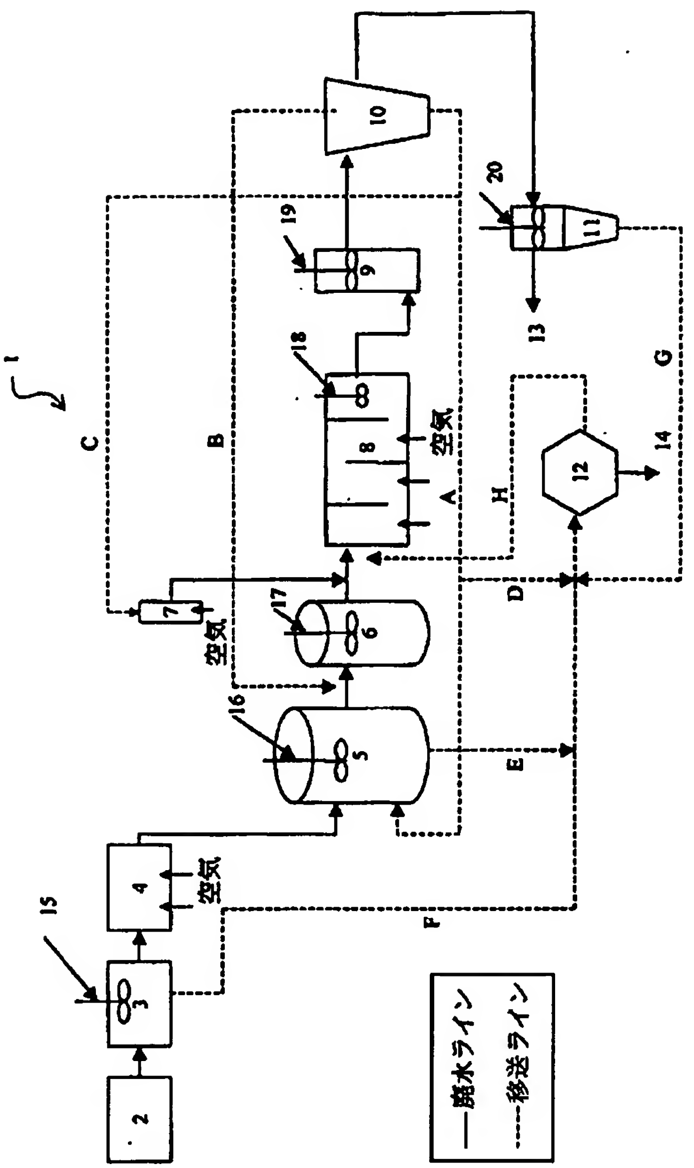
【図2】



【図3】



【図1】



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